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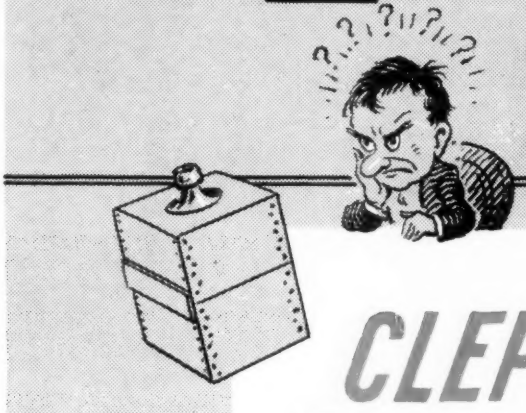

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JUNE, 1951 VOLUME 49 • NUMBER 6

CONTENTS

COMING SOON

Next month's issue will be a Special Issue devoted entirely to the theme, "How The Electroplating Industry Contributes to the Military Preparedness Program." Articles on general applications of finishing to various classes of material, as well as material on specific processes vital to the program will be included.

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Contributed articles, communications, etc., on pertinent subjects are invited. Their publication, however, does not necessarily imply editorial endorsement.

The WASHINGTON OBSERVER

George W. Grupp

News and Views from The Nation's Capitol

• To enforce compliance of all regulations, the NPA has announced that it will now make industry surveys and spot checks. All violators will be vigorously prosecuted.

• Both houses of Congress passed bills to remove the tariff of 2 cents a pound on imported copper. The final passage has been delayed because the Senate bill contained an unrelated provision which the House does not like. When this measure is finally passed buyers will be disappointed if they think they will be able to buy copper at 24½ cents a pound - the OPS ceiling price. The State Dept. has been negotiating with Chile to raise the price of such imported copper to 27½ cents a pound. This will be 3 cents a pound above what domestic copper producers will receive.

• The Munitions Board has issued an "Index of Military Purchasing Offices". This is a guide for industries selling to the armed forces. A copy may be had by addressing the Central Military Procurement Information Office, Munitions Board, Pentagon, Washington 25, D.C. To assist small business the Munitions Board has also assigned a small business specialist to each of the armed service procurement offices throughout the country.

• The NPA has placed sulfuric acid under limited allocation. Specific authorization to deliver or use sulfuric acid is now required in the states of Washington, Oregon, California, Arizona, New Mexico, Nevada, Utah, Colorado, Wyoming, Idaho and Montana. Buyers of 60 tons or less of sulfuric acid a month are exempt from this order.

• There has been established a three-man board to hear appeals for adjustments under NPA regulations and orders. All hearings will be informal and open to the public, except when national security is involved.

• Cadmium Order M-19 has been amended to permit the use of this metal for ferrous nuts, bolts, screws, washers, hi-shear rivets, lock bolts and cotter pins for aircraft use. It also permits the use of cadmium for automotive and aircraft fuel pumps and for aircraft battery hold-down bars.

• About one hundred small manufacturing firms in Omaha, Nebraska have been authorized by the Defense Production Administration to form a production pool for the purpose of speeding up defense work through prime and subcontracts.

• Silversmiths of the United States have been invited to participate in the International Modern Silverware Exhibition at Venice, Italy from July 2 to August 25, 1951.

• The metal furniture industry has been hard pressed to find substitutes for tubular chrome. No acceptable substitute has been found for nickel and copper-based chrome for their product. Paint and lacquer finishes are not sufficiently durable, and plastic finishes are not acceptable by consumers.

• The United States Treasury is wondering when India, Great Britain, Holland, Saudi Arabia, Australia, Ethiopia and the Fiji Islands will return the 410,000,000 ounces of silver which were loaned to them during World War II.

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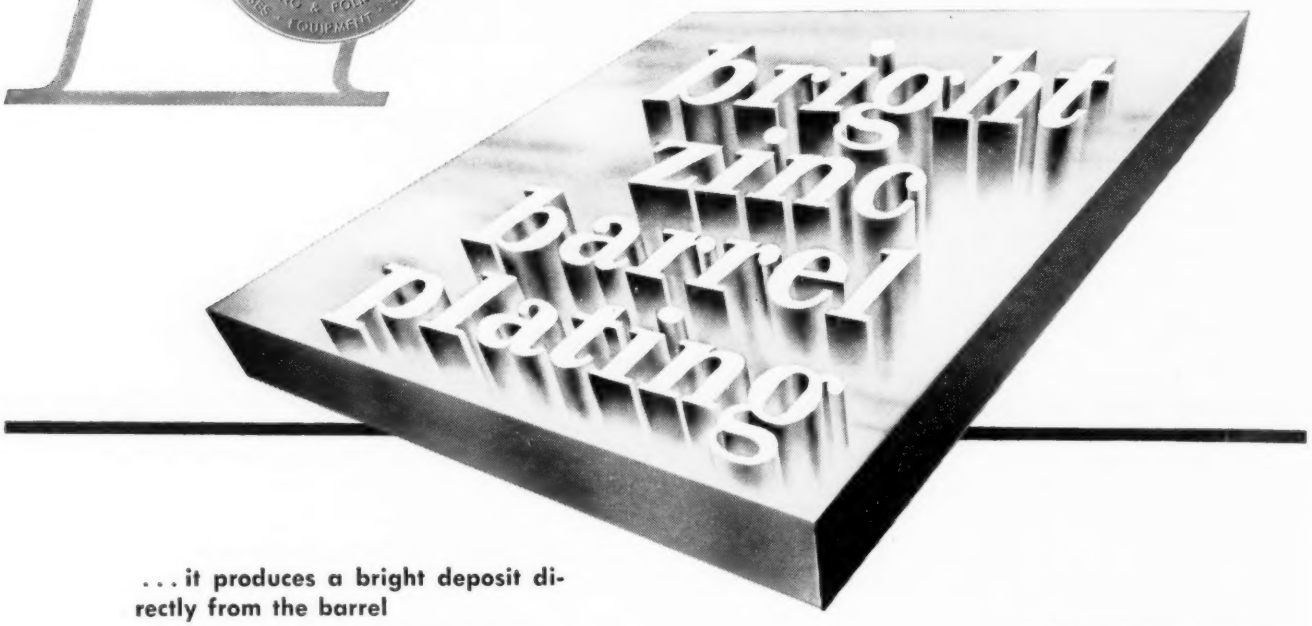

. . . it produces a bright deposit directly from the barrel

. . . it develops brilliant deposits over a wide range of current densities

. . . it eliminates need for subsequent bright dipping

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METAL FINISHING

LUME 49 • NUMBER 6 • JUNE 1951

Fact Or Fancy

As Shakespeare once said, and every human being since has oft repeated, "Ill blows the wind that profits nobody." A more appropriate expression would be hard to find to describe the present situation in the metal finishing industry.

If nothing else, the shortages and restrictions now prevalent have motivated the most intensive fact-finding program the finishing industry has ever seen—a program which is bound to uncover facts and procedures that will far outlast the present emergency.

Researchers everywhere are examining with a critical and constructive attitude the many possible alternates for the so-called "standard" finishes, and there is noted a decided tendency to disregard extravagant or misleading claims, substituting in their stead the facts established by searching, comprehensive tests in both laboratory and field. Not only technical factors, but economic and commercial considerations are being thoroughly scrutinized.

Typical of this vigorous activity is the search in the automotive industry for alternate finishes for exterior and interior brightwork. Various combinations of nickel-less, copper-less, chrome-less, and conversion types of finishes are being evaluated. Because of the time required to establish accurate corrosion and exposure test data, it is yet too early to predict which type of finish will find the most favor. One thing is certain, however—false "theories" and untenable claims will be relegated to the scrap heap, and tomorrow's finishes are certain to be superior in many ways because of new facts established here. In the face of severe competition from other sources, when and if materials again become readily available, the experience of the past year will stand the finishing industry in good stead, even though it may leave in its wake a host of prematurely gray-haired metal finishing engineers.

W. A. Raymond

Editor

Buffalo Ready and Awaiting the Invasion of the American Electroplaters' Society

By Joan T. Wiarda, *Chairman, Publicity Committee*

BUFFALO hopes to see the largest gathering of plating and finishing experts ever to meet at one time and place, during the 38th Annual Convention of the *American Electroplaters' Society* at the Hotel Statler, Convention Headquarters, July 30th, 31st, August 1st and 2nd.

The city will welcome the attending members with the Mayor's proclamation making it "*Metal Finishing and Electroplating Week*" in Buffalo.

Our Educational Sessions have been well planned and the social activities have been designed with but one thought —vacation fun all along the way.

A few high spots from the program include:

MONDAY

Keynote address by *Dr. Wm. Blum*, National Bureau of Standards—"*Electrodeposition Research at the National Bureau of Standards.*"

The International Fellowship Club luncheon at noon, for equipment manufacturers, distributors and their representatives.

The first technical session will be held in the afternoon, "*Engineering Aspects of Electroplating*" — Sessions chairman *G. W. Jernstedt.*

Monday evening will be one of gayety with the annual Open House, the contribution of the International Fellowship Club.

TUESDAY

The second technical session—"*Preparation and Plating of Zinc Base Die-Castings*"—Chairman *Dr. R. B. Saltonstall.* The Third technical session will be held in the afternoon—"*Open Forum on Substitute Finishes for Electroplating*" — Chairman *Dr. Walter R. Meyer.*

Tuesday evening will be a free one for conventioneers, with exception of the members of the *National Association of Metal Finishers*, who will hold their annual dinner at the Hotel Statler.

WEDNESDAY

The Fourth technical session "*Some Practical Aspects of Plating Room Con-*

Air view of downtown Buffalo and its harbor.

Buffalo's City Hall — a beautiful and impressive building.

trol"—Chairman *John Acheson*. Then to the the Automobile Club for Luncheon and the Annual Picnic. The old-time ball game—East versus West.

THURSDAY

The fifth technical session—"*Report on A.E.S. Research Program*"—Chairman *Guy Cole*. The final business session in the afternoon and then the Streamlined Annual Banquet — NO SPEECHES — GOOD FOOD (Roast Beef) — GOOD MUSIC.

William Fotheringham
Convention Co-Chairman.

Ladies Program

For the Ladies, a real blaze of glory is planned, as follows:

MONDAY

At noon, The "Get Acquainted and Renew Acquaintance Luncheon"—time for a few hours rest and preparation for Open House, Monday evening. In traditional style the *International Fellowship Club* will entertain the American Electroplaters' Society's wives and sweethearts.

TUESDAY MORNING

Trip to Niagara Falls, then to the General Brock Hotel, on the Canadian side of the border for lunch. The luncheon will be sponsored by *Oakite Products, Inc. Dave X. Clarin* will be host, leading and only man. Evening free.

WEDNESDAY

The Annual picnic and luncheon at the Automobile Club. Evening free.

THURSDAY MORNING

Technical session for the ladies. *Dr. R. B. Saltonstall* will divulge a number of "*Platers' Secrets*"—this session for ladies only.

Luncheon will be sponsored by the *Udylite Corp.* Professor *Saltonstall* will be our host. There will be gifts for the ladies, donated by *Detroit Chemical Specialties Co., J. J. Siefen Co., Wyandotte Chemicals Corp.*, and the traditional gift of double decks of playing cards from the *W. Green Electric Co.* There may be others.

The *Convention News*, published by The *Hanson Van Winkle-Munning Co.* will greet the conventioners each morning.

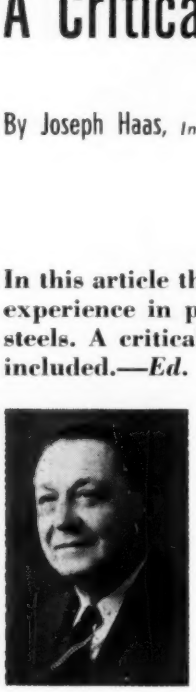
Every metal workng plant operating electroplating and related departments should be represented by as many men as can be spared from their operations and who have the capacity to learn from the presentation and discussion of technical papers which relate to the present day and future problems. There will be a warehouse of technical information awaiting your arrival in Buffalo to listen and learn at the 38th Annual Convention.

Electroplating Stainless Steels

A Critical Review with Recommended Practices

By Joseph Haas, *Industrial Engineer*

In this article the author presents data based on experience in plating various types of stainless steels. A critical review of previous methods is included.—*Ed.*



STAINLESS steel, formulated by *Henry Brearley*, an English metallurgist in 1913, had a slow start; it was not until the early 1920's that it made its effective appearance in the metal industries of this country. It hammered first and loudly upon the doors of manufacturers of kitchen ware and tableware. Manufacturers of table knives lent a ready ear, particularly manufacturers of silver plated steel knives.

There was sufficient reason why manufacturers of silver plated steel knives should be the first to listen to the advantages of having a table knife with a stainless blade. With all the large flatware manufacturers, complaints of silver plate peeling from the blades of knives, or rusting of the blades, was a routine complaint, not particularly from individual householders, but from restaurants and hotels, who generally cleaned their flatware in bulk in washing machines, causing severe abrasion. Thus, the flatware manufacturers of table knives became the first large users of stainless steel. Knife blades made of stainless steel assembled to a hollow handle presented no plating problem to the manufacturer.

However, there was a type of knife, not now manufactured because present day low-cost manufacture of hollow-handle knives has made it obsolete, that did present a problem. This knife was one made of a low carbon steel handle welded to a stainless steel blade. The low carbon steel handle was necessary so that a pattern could be embossed upon the handle. Figure 1 illustrates this type of knife.

This particular type of table knife consisted of two pieces: a soft iron (0.9% carbon) handle butt-welded to the stainless steel blade. After a burr, formed in welding, had been removed where the two metals had been joined together, the forging operations consisting of striking the handle, straight and cross rolling the blade, trimming, and straightening, followed in order. Figure 2 gives the evolution of the table knife in so far as the forging operations are concerned. Then there followed the operations of hardening, drawing the blade to temper, and the various polishing operations.

We have now arrived at the point where the question can be asked, "What was the plating problem?"

Reference to Figure 3a shows two areas of a table knife, the rim and the bolster, one of which (the rim) is completely stainless steeel, and the other (the bolster) partly stainless steel and partly low carbon steel. Furthermore, the union of the low carbon steel line with the stainless steel was not a uniform line, but was more or less as shown in Figures 3b and 3c.

It can be readily understood that to manufacture table knives of this type, perfect adhesion of the silver plate was necessary at least in the bolster, and preferably including the rim. How this was accomplished was described by *Haas* and *Unruh* in their article "Deposition of Metals upon Stainless Steel," *Metal Industry*, November, 1925. Experimental work was started in 1922, but it was not until complete practicability in consumer field usage was proved that the authors decided to publish the results of their research. A summary of this method appears later in this article.

The next industry to hop on the band wagon of stainless steel was the fountain pen industry. Good fountain pens had pen points of 14K gold. Cheap foun-

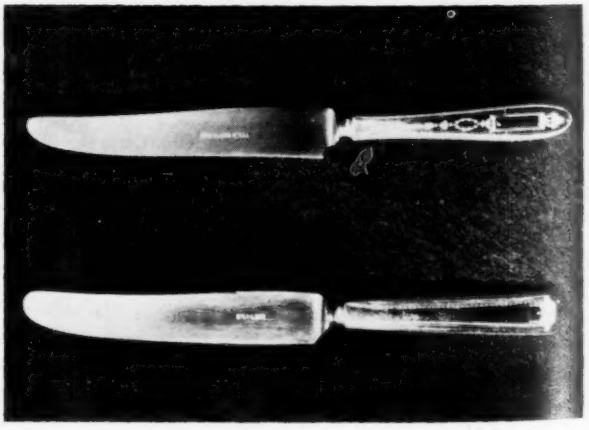


Figure 1. Table knife made by welding a low-carbon hollow handle to a stainless steel blade.

tain pens had steel pen points, gold plated, which soon rusted, and caused consumer dissatisfaction. Fountain pens with stainless steel pen points, gold plated, began to flood the country in the early 1930's.

As stainless steel products increased in application, statements were made that the electroplating industry would be materially affected by this wonderful noncorrosive metal consisting of a solid solution of chromium, nickel and carbon in iron. However, this wonderful metal has its limitations, and for one or another reason, it was necessary to plate stainless steel.

At the time some manufacturers entered the field to manufacture kitchen ware, namely pots and pans, from sheet stainless steel, the old cast iron type and enamel ware had already been replaced by aluminum. While this aluminum type of kitchen pots and pans were lighter and easier to clean than the old cast iron type, and had the advantage over the enamel ware which chipped and sprung holes, it was still heavy and had a tendency to become pitted and stained. Manufacturers entering the pot and pan field with stainless steel did so on the basis that their product would be lighter than aluminum, easier to clean and would not corrode and pit at all. However, they found themselves with a problem. The reason for this was that stainless steel has a low heat conductivity. It absorbs heat slowly, and distributes it slowly. Consequently stainless steel was unsuccessful in this field, until one manufacturer solved this heat conduction problem by cladding the outside bottom of stainless steel kitchen ware with copper, by means of copper plating.

The plating of stainless steel is by no means confined to the above three industries. Today the plating of stainless steel has reached wide and diversified application. Large quantities of stainless steel are chromium plated for appearance in the automobile industry, for instance.

Nature of Passivity of Stainless Steels

Passivity of metals may be defined as a surface inactivity or inertness to chemicals or influences which ordinarily attack them. The true nature of the protective action of chromium upon the corrosion of iron has not been fully or conclusively established. However, the oxide film theory is quite generally accepted. According to this theory a tightly adherent chromium oxide film forms on the surface of the steel. This film is so thin that it cannot be seen with the most powerful microscope. When the film is broken, if oxygen is present, the invisible film reforms instantly, therefore maintaining its protective function.

Because passivity can be imparted to ordinary iron, even though such passivity is temporary or for only a short duration, the oxide theory is open to considerable doubt. For example, iron immersed in fuming nitric acid is for a short time immune to attack by dilute nitric acid or sulphuric acid, and iron so treated will not replace silver or copper from dilute solutions of their nitrates. Other oxidizing agents also produce this same effect. However, the passivity of iron produced in this manner is only temporary, whereas the protective agent in the case of high chromium-iron alloys is much more stable. But the temporary passivity produced by fuming nitric acid and other oxidizing agents upon

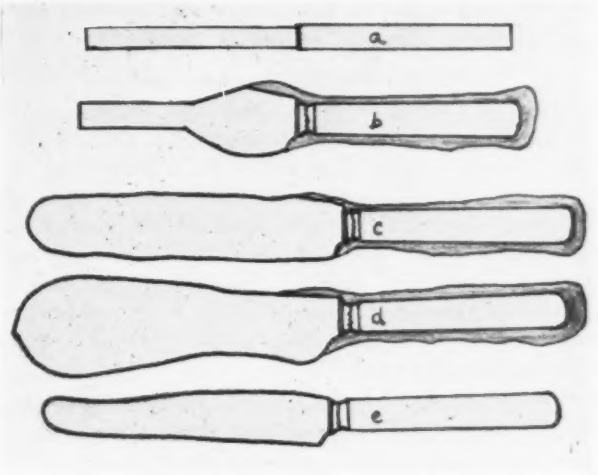


Figure 2. Steps in the forging of the welded type knife.

iron makes the passivity of stainless, as advanced by *Uhlig* and *Wulff* in 1939, a more acceptable theory.

Uhlig and *Wulff* reported extensive investigations into the nature of the surface of stainless steels. They found the oxide film theory inadequate, and offered an electronic theory to explain the passivity of metal surfaces. Their results indicated that the protective film, if it does exist on stainless steels, consists of oxygen mechanically adsorbed at the extreme surface, rather than a film of metallic oxides. The writer is inclined to go along with this theory for reasons that will be explained later.

Regardless of the cause or nature of the passivity of stainless steel, the important thing is that stainless steel cannot be plated in the same manner as regular iron or steel.

Hydrogen Absorption and Adherence of Deposits

While it is well known that the electroplating of hardened high-carbon steels presents problems not found with low carbon steels, and difficulty is experienced in obtaining maximum adhesion of any electrodeposited metals, little definite information or experimental data exists similarly for stainless steels. The writer has only been able to find data reporting the affinity of stainless steels for hydrogen absorption with resulting embrittlement during acid pickling operations for the removal of scale.

Nor has the writer experienced any such embrittling effects or poor adhesion of deposits during the series of experiments that were performed for the purpose of this article. This may be attributed possibly to the short cycles of operations involving hydrogen evolution either cathodically or in acid dips, as the part hydrogen plays in embrittling the steel base, its effect on adherence, and ductility of the deposited metal was kept in mind.

As the same cycles used on hardened high carbon steels has resulted in blistered, poorly adherent electrodeposits, the writer believes that *Uhlig* and *Wulff's* theory of adsorbed oxygen at the extreme surfaces of stainless steels is the factor minimizing the effects of the small amounts of hydrogen evolved in controlled short cycles.

A Review of The Literature and Patents on Plating Stainless Steel

1. *Process for Plating Stainless Steel and Articles Produced Thereby.* Patent application filed Dec. 24, 1921. Patent #1,501,049 issued July 15, 1924. *A. Harper.* This patent, the first issued for a process of plating upon stainless steel, depends primarily upon the etching effect of hydrofluoric acid for adhesion of subsequent deposits. The deposition of nickel, after etching, is a primary requisite. Silver, deposited directly upon stainless steel after treatment recommended by the patentee, does not adhere when subjected to bending and heating tests.

2. *Deposition of Metals Upon Stainless Steel.* Haas and Unruh, *Metal Industry*, Nov. 1925, p. 451. Cathodic treatment of stainless steel in 25% sulphuric acid, or 30% hydrochloric acid, 4-6 volts, 140°F., with a lead anode, which later in practice was replaced by carbon. Also later, in practice the writers used concentrated hydrochloric acid. While no mention was made of the time of the cathode treatment, this cathodic treatment was for 45-60 secs. This article was the first published article relating to the problem of plating stainless steel, and the first to offer an explanation of the difficulty involved, and a solution of the problem.

3. *Silver Plating of Tableware.* Elmer R. Unruh, *A.E.S. Monthly Review*, Feb. 1927. Paper read before Dayton Branch A.E.S. in which the silver plating of knives with stainless steel blades was outlined, based on four years experience of cathodic treatment in concentrated hydrochloric acid.

4. *Plating Stainless Steel.* Joseph Hoefer, *A.E.S. Monthly Review*, Sept. 1933. Paper describing the use of various dips as an aid to plating on stainless steel, best results being obtained by using a pre-dip without current consisting of nickel chloride (16 ozs./gal.) and 6 N hydrochloric acid, and then plating in a nickel solution of the following composition:

Nickel Sulphate	28 oz./gal.
Nickel Chloride	7 "
Boric Acid	3 "
pH	2.5
Temperature	125°F.
Current Density	35 a.s.f.

5. Patent application serial #707,502. *Hiram S. Lukens*, January 20, 1934. This patent application was the second filed for a method of plating upon stainless steel, ten years after Harper's patent was issued, and nine years after *Haas* and *Unruh* published details of how to successfully plate upon stainless steel.

6. *Method for Gold Plating.* Patent #2,039,328. May 5, 1936. *Hiram S. Lukens.* Describes method of gold plating stainless steel pen points from a gold solution containing free hydrocyanic acid. This patent was filed as application #707,502.

7. *A Simple Method of Nickel Plating on Stainless Steel.* Donald Wood, *Metal Industry*, July 1938, p. 330-331. Outlines a cathodic treatment of stainless steel in a nickel chloride and hydrochloric acid solution. Recommended solution is:

Hydrochloric acid (22° Bé)	16 fl. oz./gal.
Nickel Chloride	32 oz./gal.

This solution is operated at room temperature, from a 6 volt line, at 50-75 amperes per square foot. Time of treatment — 2 minutes. Anodes — electrolytic nickel sheet. After this 2 minute cathodic treatment (resulting in a deposit of nickel), and after rinsing, other plating can be proceeded with.

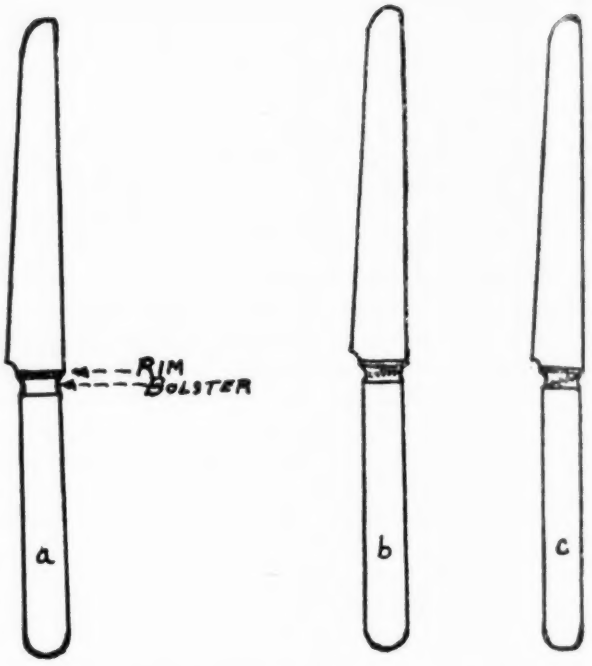


Figure 3. Critical areas of the knife, for plating, are the rim and bolster.

8. *Process for Gold Plating Chromium Alloy Steels.* Patent #2,133,995. October 25, 1938. *Hiram S. Lukens.* Details the necessity for treating stainless steel in a hydrochloric acid electro-pickle before proceeding with gold plating stainless steel pens.

9. *Improvements in the Electrodeposition of Metals on Alloys Containing Chromium.* British Patent #503,008. March 29, 1939. *The Mond Nickel Co.* Details of a nickel chloride-hydrochloric acid solution, the treatment of stainless steel anodically for a 2 minute period and then making it the cathode in the same solution to deposit a protective coating of nickel for a 6 minute period, after which the articles can be plated in any other solution.

10. *Copper Coated Cooking Vessel.* Patent #2,272,609. Feb. 10, 1942. *Kennedy, Knight,* and *Lee* (assigned to Revere Copper & Brass Inc.) Details the copper plating of stainless steel cooking vessels. The method described in this patent is unnecessarily complicated to attain its objective, in the author's opinion.

11. *Process of Electrodepositing an Adherent Coating of Copper on Chromium-containing Alloys of Iron and/or Nickel.* Patent #2,285,548. June 9, 1942. *Andrew Wesley,* assigned to The International Nickel Company. This patent is a repetition of the Mond Nickel Patent #503,008.

12. *Method of Copper Plating Stainless Steel Cooking Vessels.* Patent #2,363,973. Nov. 28, 1944. *Kennedy, Knight,* and *Lee,* (assigned to Revere Copper & Brass Inc.). Extension of claims supplementing previous patent #2,272,609.

13. *Process for Electrolytically Treating Stainless*

Steel Articles. Patent #2,422,903. June 24, 1947. *Kenneth M. Huston,* (assigned to Western Electric Co.). Stainless steel articles are electrolyzed as the anode at a current density of 350-540 amperes per square foot in a solution of 10%-60% fluosilicic acid, for a period of 20 seconds to 2 minutes, maintaining the solution at a temperature not exceeding 85°F. After rinsing the anodically treated articles in water, they are immediately placed in a cyanide brass plating solution of such composition as to deposit a brass plate containing 70%-80% copper.

14. *Activating and Electroplating Stainless Steel.* Patent #2,437,409. March 9, 1948. *William M. Tucker* (assigned to Eastman Kodak Co.). This patent relates essentially to the method of treating and plating stainless steel as described by *Haas* and *Unruh,* using Donold Wood's nickel strike as an intermediate step.

15. *Chromium Plating Large Stainless Steel Welded Assemblies.* Herborth E. Head, "*Plating,*" March 1950, page 260. Article pictorially illustrated explaining purpose of chromium plating and the overcoming of problems involved and encountered.

16. *Adherent Electrodeposits of Nickel on Thin Films of High Chromium Alloys.* Lorn L. Howard, "*Plating,*" April 1950, page 373. Describes method of depositing nickel upon thin films of high chromium alloys.

Comments on Literature and Patents

1. *Haas* and *Unruh* in 1925 made the following statement: "The only satisfactory treatment was found to be to submit the steel to the action of a direct current in an acid solution. Cyanide appears to be detrimental to the surface of stainless or high chromium." After treating stainless steel in their hydrochloric acid activating solution, they attempted to plate in various cyanide solutions, directly upon the stainless steel, without an intermediate coating of nickel. In all cases the result was a peeled and blistered deposit. At this time, the writer attributes this failure in cyanide solutions to the fact that the treatment of 45-60 seconds was too short. Recent research on plating stainless steel has resulted in successfully plating from cyanide solutions, after proper treatment in the activating solution,* details of which are given later in this article.

2. The plating of stainless steel, once it has been properly activated, presents no problem in any type solution. All the claims of patents of anodic treatment, then cathodic treatment in the activating solution, metal content, special electrolytes, current densities, etc. are, in the author's opinion, unnecessary. For example, stainless steel, cathodically activated for two (2) minutes in a 10% by volume sulphuric acid solution may be successfully directly plated in an acid copper solution, so as to copper clad stainless cooking utensils. However, sulphuric acid, in the opinion of the writer, is not as good an activator as hydrochloric acid. This conclusion has been reached after very careful and extensive recent research on the electroplating of stainless steel.

**Provided that after a quick strike of 15-20 seconds, the balance of the plating can be carried on without perceptible evolution of hydrogen.*

Master Chart for Plating Stainless Steel

The following list of operations is presented for plating any type of stainless steel. After operation #5, the choice of treatment is optional, the writer preferring the hydrochloric acid electro-activator as the most reliable and producing the most uniform and successful results. In Table 1 is presented operation sequences of plating stainless steel, any one of which will give successful results.

Table 1

Recommended Practices for Plating Stainless Steel

Method	OPERATION 6	7	8	9	10	11	12	13	14	15	16	17	18
1	x	x	x	x	x							x	x
2	x	x	x	x	x	x	x					x	x
3	x	x	x	x	x	x		x	x			x	x
4	x	x	x	x	x	x		x		x		x	x
5	x	x	x	x	x	x					x	x	x
6	x		x	x	x							x	x
7	x		x	x	x	x	x					x	x
8	x		x	x	x	x		x	x			x	x
9	x		x	x	x	x*		x		x		x	x
10	x		x	x	x	x					x	x	x
11		x	x	x	x							x	x
12		x	x	x	x	x	x					x	x
13		x	x	x	x	x		x	x			x	x
14		x	x	x	x	x		x		x		x	x
15		x	x	x	x	x					x	x	x
16		x	x				x					x	x
17		x	x					x	x			x	x
18		x	x					x		x		x	x
19	x		x				x					x	x
20	x		x						x			x	x
21	x		x							x		x	x
22	x		x								x	x	x
23	x										x	x	x
24											x	x	x

Operation Details

1. Stainless steel pre-cleaned with trichlorethylene degreaser, or any other satisfactory method.
2. Electro-clean:—180°-190°F.; 6 volts.
   (a) Direct — 30 secs.
   (b) Reverse — 30 secs.
   (c) Direct — 30 secs.
3. Water rinse.
4. Acid dip.
   Fluoboric acid 25% — 30 secs.
   or
   Hydrochloric acid 25% — 30 secs.
5. Water rinse.

From here on treatment is optional. See Table 1 for recommended steps.

6. Electro-Activator Solution: — 70°F.: 6 volts: carbon anodes.
   (a) Hydrochloric Acid 50% — 2 minutes
   or
   (b) Sulphuric Acid 10% — 2 minutes
7. Nickel Strike Solution: — 70°F.: 3-4 volts: 2 minutes: nickel anodes.
   Nickel Chloride 32 ozs./gal.
   Hydrochloric Acid 16 fl. ozs./gal.
8. Water rinse.
9. Rinse:—Nickel sulphate solution—32 ozs./gal.; pH 5.6.
10. Nickel Plate: — 70°-110°F.; 1.75 - 2 volts; 10 minutes.

Nickel sulphate	24 ozs./gal
Nickel chloride	8 "
Boric Acid	2.5 "
pH	5.6-5.8

11. Water rinse.
12. Acid Copper: — 70°F.; 0.5-0.75 volts: 30 minutes.
    Copper sulphate 32 ozs./gal.
    Sulphuric acid 8 fl. ozs./gal.
13. Electro Cyanide (6 ozs./gal.) 110°F.; 15 secs.
14. Cyanide Brass—(Standard brass) pH 12.2: 10-20 minutes.
15. Cyanide (Dupont H.S.) Copper: — pH 11.2-11.8.
16. Chromium Solution:—standard solution: standard operating conditions: 2-3 minutes.
17. Water rinse.
18. Hot water dry.

Notes Pertaining to Practices for Plating on Stainless Steel

1. *Rinsing.* Insufficient or incorrect rinsing after each treatment cycle is recognized as the cause of a large portion of plating difficulties. Plating room layouts are notoriously delinquent as far as adequate rinsing facilities are concerned. Warm or hot rinses should be used following alkaline cleaning, but the temperature should not be so high that the metallic surfaces dry between processing steps. The warm rinses should be followed by cold water rinses, either dip or spray, but preferably spray.

2. *Surface Conditioning.* Depending upon the metal to be plated on stainless steels, different treatment steps are advisable. Particularly in the plating of stainless steels, conditioning the surface of the stainless steel by a rinse in a solution equivalent to the plating solution is highly recommended. For example, before plating in an acid type solution, immerse in a weak or dilute acidified solution of the metal to be plated: before plating in a cyanide solution immerse in a sodium cyanide solution.

3. Sulphuric acid, as an activator is not recommended over *10%*, because in greater concentrations the chemical action on the stainless steel is sufficient to make subsequent plating questionable.

4. When the final coating is nickel, plating time should be sufficient to give a thickness that can be color buffed.

5. When it is specified or desired that stainless steel have an undercoat of nickel before chromium plating, color buff nickel after a 15 minute plate.

6. *Method #20.* After operation #8, immerse in sodium cyanide solution, 8 oz./gal. at 110°F.; transfer to Rochelle copper strike solution — 15-20 secs., cathode agitation, at 2½-3 volts; rinse, and place in brass solution. Operate brass solution at 1.75-2.00 volts with cathodic agitation.

7. *Method #21.* After operation #8, immerse in sodium cyanide solution, 8 oz./gal. at 110°F.; transfer to Rochelle copper strike solution — 15-20 secs., cathode agitation, at 2½-3 volts; rinse and place in high-speed copper solution. Operate at 1.00-1.25 volts with cathodic agitation. Silver may be plated on stainless steels, substituting the silver strike for the copper strike.

8. *Method #23.* No electric current used in operation #6; merely two (2) minutes agitated immersion.

9. *Method #24.* Chromium plating on stainless steels directly presents no problem, because the chromium solution is in itself an activating solution.

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Typical of the many plastic parts that are plated with metal in large quantities at Electrochemical Industries.

Production Plating of Plastics

By W. A. Raymond, *Engineering Editor*

THE many advantages to be gained from a combination of the properties of plastics and metals, in the form of plated plastic parts, has been recognized for a number of years. Today, the actual operations of putting the plated deposit on the plastic surface are fairly well known, and plated plastics now form a significant part of the total output of plating plants in this country.

While most installations for plating on plastics are rather small and specialized in the nature of their work, several firms are doing sufficient business to warrant the installation of full scale production equipment. One of such firms is *Electrochemical Industries*, in Worcester, Mass.

Under the direction of *Dr. Harold Narcus*, well-known authority in this field, Electrochemical Industries has built up a large and varied plastic plating business. One of the pioneer firms in the plating of plastic bottons and novelties, the firm has been in business over five years on a high production basis, during which time they estimate that they have plated well over 600 million parts, including the entire range of plastic compositions.

Equipment

Because of the rather specialized nature of plastic plating operations, standard plating equipment cannot be used in most cases, and this firm has developed over the years equipment based on their experience and particularly suited to their operations.

One practice of particular importance at Electrochemical Industries is the use of stainless steel processing tanks throughout, not merely for longer life, but also to eliminate the possibility of solution contamination spoiling the critical metallizing solutions.

The pictures accompanying this article give an idea of the firm's equipment.

Notes on Operations

Practically all small plastic parts are first given a de-glazing and roughening treatment to improve the bond of the subsequent conductive deposit. This roughening is done in iron tumbling barrels (Figure 1), using medium-fine pumice powder and sufficient water to make a slurry. The parts are then thoroughly washed and transferred to wire baskets for the sensitizing operation.

The sensitizing solutions are contained in glazed ceramic crocks. See Figure 2. The particular sensitizing bath used depends on whether a silver film or a copper film will be next applied. Although the silver film is most common, the firm is also equipped to deposit a copper film as a primary conducting coating. This latter process is covered by patents owned by the firm (see *Metal Finishing*, Sept. 1947 for a description of

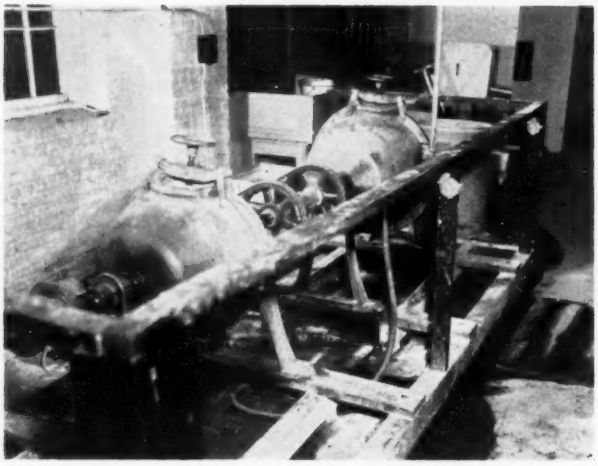

Figure 1. Pumice rolling equipment for roughening the surface of plastic parts prior to chemical treatments.

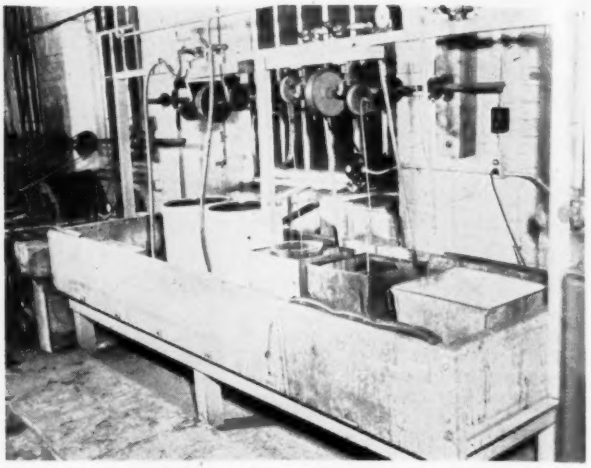

Figure 2. At this station the parts are given a sensitizing treatment to promote a good silver conductive film in the next operation.

this process). Generally speaking, the copper film method is not used on sharp-cornered parts, but where it can be used it does deposit a more continuous and better conducting film than the silver. The copper film produced in this way does not exhibit the typical bright red color of copper.

During the sensitizing treatment and the subsequent rinses, the parts are gently agitated by means of an eccentric wheel on which the baskets are hung.

After sensitizing, the parts are transferred to the 5-gallon glass jars shown in Figure 3, the proper silvering or coppering solutions poured over the parts, and the jars capped and placed in the rotating device shown. It takes approximately 20 minutes for the reaction to be completed, after which time the spent solution is poured off and several washings of water introduced to rinse the parts. At this point the operator checks several samples from each jar for conductivity of the coating, using a small battery-operated milliammeter device. No attempt is made to salvage any silver from the spent solution. After a long series of tests this firm has adjusted the compositions of their silvering solutions so that the silver is practically 100% precipitated.

Plating Operations

After the deposition of the conducting film, the parts are transferred to the plating barrels shown in Figure 4, where the heavy copper coating is applied. A high-speed copper bath is used here to deposit approximately .003" of copper in a smooth condition, in 8-12 hours.

After copper plating the parts are ball burnished bright in the apparatus shown in Figure 5. The arrangement of screens underneath the barrel, to separate the fine balls from the work, was developed at this firm many years ago and is a feature now incorporated in much of the commercial tumbling equipment now on the market.

Following bright burnishing, the parts then go either to the nickel, silver, or gold barrels for the final surface coating. Bright nickel, silver, and gold are the most commonly specified finishes, but oxidized or "antique" finishes are also quite common. This oxidizing is done by conventional techniques, dipping in chemical oxidizing baths and relieving the raised areas by ball burnishing. Contrary to most decorative plated works, chrome plating is seldom called for as a final coating.

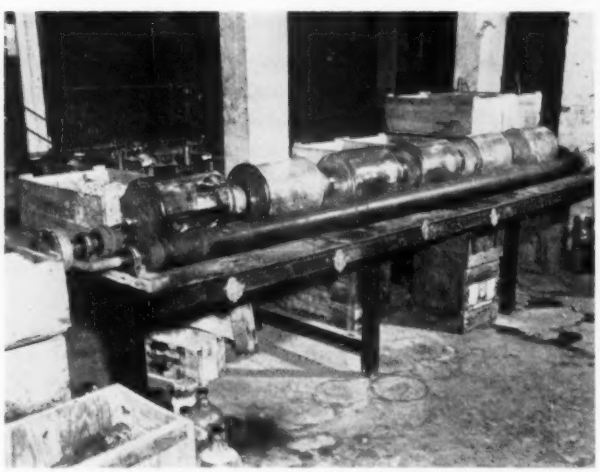

Figure 3. Jar rolling set-up for putting the immersion silver conducting coating on small items such as buttons, pins, novelties.

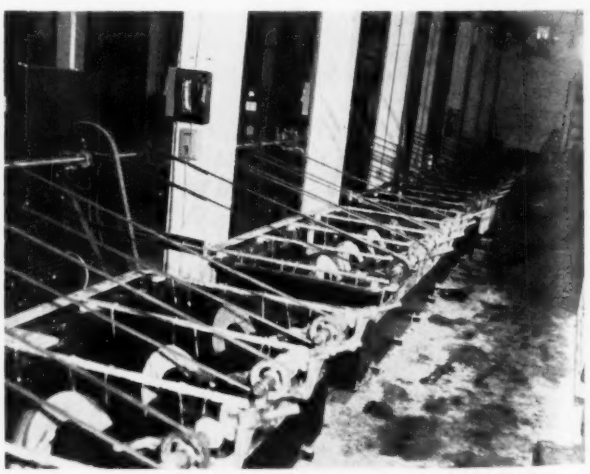

Figure 4. View of one of the barrel copper plating lines for depositing heavy copper coating over the primary conductive film.

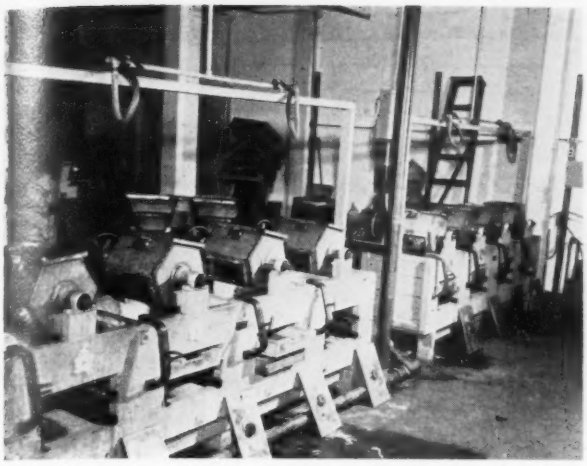

Figure 5. Ball burnishing is used to provide luster on the copper plated coating.

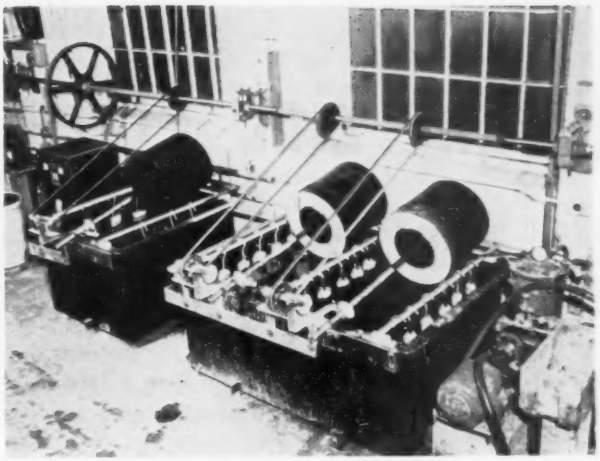

Figure 6. Left, silver plating barrel; right, two nickel barrels for plating over the original copper deposit, when required.

although it has been specified and done in a few instances.

Spray Silvering

There are a great many plastic parts whose size or shape does not permit handling in bulk. In such cases the silver conducting film is applied by spraying, after which the parts are racked and plated in the conventional manner. A simple set-up for silver spraying is shown in Figure 8. The tanks at the left contain cleaner, sensitizer, and rinses. The spray booth and special spray gun are also shown.

A variation in the silver spray technique is the application of mirror silver films on both plastic and metal parts. In this technique the parts are first coated with a heavy-bodied lacquer, which is usually baked at a low temperature. This step produces a smooth, glossy lacque film; on many small costume jewelry parts no preliminary burnishing nor buffing is required. The mirror silver film is then sprayed on, using specially formulated solutions, dried, and top-coated with clear or tinted baking lacquer. The result is a lustrous, pleasing finish, quite popular nowadays on costume jewelry and novelties because no plating of critical metals is necessary.

For white metal castings, it is recommended that a light phosphate coating (about 2 minutes in any regular phosphating solution) be used before the primary coat of glossy lacquer is applied. The base lacquer is applied by dipping, the excess being spun off in a centrifugal spinning device, and baked. After this the parts follow the routine described above. Several variations in this sequence are possible, such as dyeing the top coat by immersion in dye solutions, etc.

Plastics usually only require a preliminary dip in hydrocarbon solvents prior to the initial dipping lacquer operation.

In all the operations in this plant extreme care is taken to avoid contamination of the delicate silver immersion and sprayed films. These precautions are essential to successful operation on a high production basis.

Electrochemical Industries was honored by being one of the few plating plants in the U. S. to which a visiting Metal Finishing Specialist Team from England specifically requested a visit.

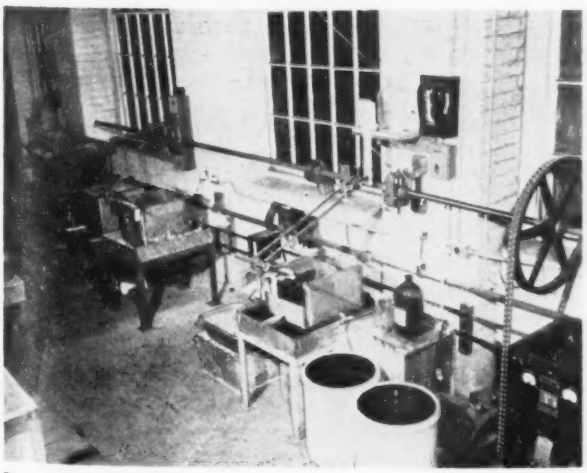

Figure 7. A small gold plating set-up for special buttons and other items.

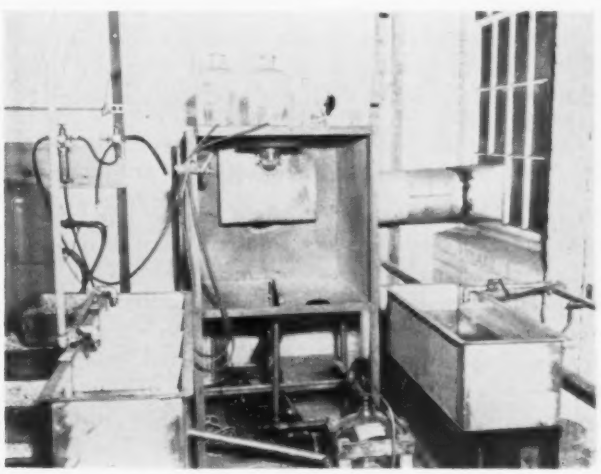

Figure 8. Spray booth set-up for spraying silver films on parts which are not adaptable to barrel treatment.

Bright Zinc Plating

By R. O. Hull and J. B. Winters, R. O. Hull & Co., Inc., Cleveland, O.

THE current defense situation is serving to focus the attention of the plating industry upon bright zinc plating to an unprecedented degree, because of the necessity for conversion to zinc from less available metals. Numerous plants heretofore devoted to copper-nickel-chrome or to cadmium plating are finding bright zinc to be quite a different plating system from those to which they have been accustomed. There are numerous pitfalls in such conversions that can easily be avoided by the proper knowledge of the technique of bright zinc plating. When these pitfalls are duly recognized and steps taken to avoid them, bright zinc plating is not at all difficult to carry out in continuous production with highly satisfactory results.

Undoubtedly the one point of paramount importance in bright zinc plating is that the bath is extremely susceptible to impurities, chiefly metals including nickel, chromium (hexavalent), cadmium, lead and copper. The presence of even small concentrations of salts of these metals in zinc baths gives effects varying from no plate, dark or poor deposits from the bath, to deposits that are unstable and darken rapidly upon standing. It follows that anodes must be of high purity (High Grade or Electrolytic) and salts must be equally free from metallic impurities. Even the highest purity anodes commercially available contain lead in sufficient amount that daily purification with a precipitating compound is very desirable. (This precipitating compound may be sodium sulfide, but prepared purifiers are more active and work faster.) Salts for the initial solution contain impurities, so that purification of the bath by considerable electrolysis is usually necessary to give deposits that do not darken rapidly.

The problem of metallic impurities is so important that separate rinses should be used for zinc plating alone and not intermixed with rinses for cadmium or other types of plating. Even residual metal in rinse solutions may produce dark zinc surfaces and must be avoided.

Conversion to Zinc

Good initial operation of bright zinc in new equipment is usually much easier to attain than in conversions from other types of plating baths. With new equipment, simple electrolysis, with purifier, usually gives very acceptable bright zinc in a day's time. Conversion of cadmium tanks is the most troublesome and can be accomplished successfully only by complete elimination of cadmium metal and solution from the plating tank, barrels and other equipment. The procedure is to remove all traces of metallic cadmium from the tank sides by deplating so that the tank (if steel) is anodic, and either the regular anodes or pieces of sheet steel, insulated from the tank, are made cathodic for a long enough time to insure all cadmium being removed. Either the regular cadmium bath or a sodium cyanide solution containing one-half to one pound per gallon may be used. Deplating in the regular solution may be continued, if desired, to reclaim cadmium until the metal content is about one-half ounce per gallon, after which the solution is discarded, with due regard to waste disposal of cyanide.

If time does not permit deplating, cadmium metal may be chiselled or ground off of the tank sides, but *never* melted off with a blowtorch, because of the extreme toxicity of cadmium vapors. After deplating or mechanical removal of cadmium, tanks and barrels should be thoroughly rinsed and soaked for several hours (up to 24 hours) in a solution containing one percent by volume muriatic acid plus 8 oz./gal. ammonium nitrate, then again rinsed well before making up the zinc bath.

Conversion from copper barrels and still tanks is similar to cadmium in that the tank is deplated and all copper removed mechanically. In this case, a hot cyanide solution may be used to soak barrels and the tank for the time necessary to dissolve residual copper. This may require one to two days, keeping the cyanide solution at the maximum temperature possible and bearing in mind temperature limitations of barrel equipment. The only recourse in conversion of nickel barrels is mechanical removal of nickel metal and soaking of equipment for several days in hot water before making up the zinc bath. Metallic nickel is not readily dissolved in the zinc solution, but salts of nickel must be absent to avoid later difficulty in zinc plating.

Preparation of Zinc Baths

There are three general methods for preparing bright zinc baths, i.e.,

(1) Using zinc cyanide
(2) Using high purity (U.S.P.) zinc oxide
(3) Electrolysis with zinc anodes.

STILL OR AUTOMATIC PLATING

	Bath #1 oz./gal.	*Bath #2 oz./gal.*
Total sodium cyanide	12.3	14.0
Zinc metal	4.5	6.0
Caustic soda	10.5	15.0

To make the above baths, the following components are used:

Sodium cyanide	5.6	5.0
Zinc cyanide	8.0	10.0
Caustic soda	10.5	15.0

Alternatively, zinc oxide (U.S.P. only) may be used in the following formulations:

Sodium cyanide	12.3	14.0
Zinc oxide	5.6	7.5
Caustic soda	5.0	7.4

The No. 1 bath gives higher covering power, somewhat less ductile deposits and operates at a somewhat higher voltage than the No. 2 bath. However, the latter deposits zinc at a faster rate and higher current density than the No. 1 bath.

BARREL PLATING

	Bath #1 oz./gal.	*Bath #2 oz./gal.*
Total sodium cyanide	10.5	12.3
Zinc metal	4.5	4.5
Caustic soda	8.0	10.5

To make the above baths, the following compounds are used:

Sodium cyanide	3.8	5.6
Zinc cyanide	8.0	8.0
Caustic soda	8.0	10.5

Alternatively, zinc oxide (U.S.P.) may be used in the following formulations:

Sodium cyanide	10.5	12.3
Zinc oxide	5.6	5.6
Caustic soda	2.4	5.0

Bath No. 1 gives higher covering power in dense loads or with metal difficult to plate, small parts, operates at higher voltage and dissolves zinc anodes slower than Bath No. 2. It is not quite as good in plating light weight work, such as thin metal sections, large pieces or open loads.

The effect of temperature differences between summer and winter is important in zinc plating and in general higher temperatures (up to 100°F.) require higher total sodium cyanide to zinc metal ratios as follows:

	Still		*Barrel*	
Temperature °F.	*Bath #1*	*Bath #2*	*Bath #1*	*Bath #2*
70- 80	2.7	2.3	2.3	2.7
81- 90	2.8	2.5	2.5	2.8
91-100	3.0	2.7	2.7	3.0

Since both zinc cyanide and zinc oxide may not be readily obtainable, electrolysis affords a means for preparation of a high-purity zinc bath, but is subject to the distinct disadvantage of requiring a considerable amount of time and effort. The initial solution required is the same as the one selected from the above formulae for zinc oxide, using only the quantities of sodium cyanide and caustic soda, for the reason that building up of zinc metal by electrolysis is equivalent to using zinc oxide. Thus for electrolysis preparation of Bath #1 for still plating, a bath containing 12.3 oz./gal. sodium cyanide and 5.0 oz./gal. caustic soda is used.

If the *cathode* efficiency were zero in making up the bath, 10,500 ampere hours per 100 gallons would be required to build up the zinc, but because some zinc plates out, an amount of electrolysis up to 16,000 ampere hours per 100 gallons may be required. Zinc anode area should be as large as possible and cathodes should be small in area — about one-fourth the anode area. By using carbon slabs or cast iron bars as cathodes, it is possible to take advantage of the inability of zinc to readily plate over these types of materials so that the desirable effect of low cathode efficiency may be attained; otherwise steel may be used as cathode. After initial passage of 10,000 ampere hours per 100 gallons, the bath should be analyzed (after stirring) for zinc metal as well as sodium cyanide and caustic soda. Brightener and purifier solutions may be added and production initiated only when the zinc content reaches 4 ozs./gal. Obviously, the cathodes used, if zinc plated, may be subsequently used as anodes so that no zinc is wasted.

Bath Maintenance

The composition of the zinc bath should be maintained to the concentrations given as minimum values and may be allowed to rise up to 10% above the values given. In barrel plating running 16 or more hours per day, the zinc metal concentration may tend to drop. This can be minimized by insuring perfect contact between busbars and anode bars, by keeping anode baskets full, and by using auxiliary zinc anodes contained in a steel basket or coarse steel screen elevated slightly above the bottom of the tank, to take advantage of the ability of zinc metal to go into solution by electrolytic action in contact with steel. Rising zinc metal content is readily corrected by removing part of the anodes, leaving some baskets empty or partially filled.

Usually in still or automatic baths, an anode area equal to the cathode area may first be tried to establish whether the zinc content rises or falls. As mentioned above, suitable adjustment of the zinc anode area may then be made to keep the zinc metal concentration constant in the bath.

One method is useful in preventing zinc from dissolving chemically when the bath is idle for several days. This is to impress a reverse current during idle periods so that the zinc anodes are made negative or cathodic to the extent of 0.2 amp./sq. ft., at a voltage of 2.0 to 2.1. The positive electrode may be a small area of plain steel hung on the cathode bar. This can easily be made into a permanent installation so that during idle periods, the plating generator is disconnected and a small counter-current rectifier connected to the anodes to give the necessary current to prevent solution of the zinc.

It is apparent that harmful metals must be kept out of contact with bright zinc baths and only iron and steel tanks and coils may be used. Anode bars should preferably be steel. A method of insuring perfect anode bar to basket content is to submerge *steel* anode bars beneath the bath surface. This entirely avoids crystallization of salts on and between anode baskets and bars.

One difficulty particularly noticeable in summer is adequate cooling of barrel zinc baths, ordinary cooling coils usually proving to be ineffective. An effective means for cooling is spraying water on the outside of the tank and in extreme circumstances, ice may be held between the tank and an inclined board. In many instances, auxiliary cooling by refrigeration is justified. As mentioned before, temperature control is important in zinc plating, as the rate of brightener consumption is usually multiplied rapidly with increase in temperature. The optimum temperature is between 85° and 90°F., with a minimum of 75°F. Operating a zinc bath below 80°F. can be as serious and troublesome as operating it

too hot. At low temperature the bath tends to produce non-uniform deposits, grey or even blistered deposits, and the process is more susceptible to changes in cleaning or base metal surface conditions.

Brightening agents are almost entirely proprietary products. They are not only essential to production of bright deposits but also should greatly improve covering power in recesses as well as improving throwing power. Suppliers of these products provide the information necessary regarding the required additions. Brightening agents also perform the function of minimizing the time required for bright dipping (see below) and hence greatly increase the length of life of such dips. They also reduce the amount of zinc removed in bright dips, which is particularly noticeable in recessed parts.

In addition to brightening agents, a purifier solution should be added to the bath daily. Such prepared solutions are readily obtainable. The effects of the purifier are to keep small amounts of lead and cadmium precipitated and also, in many cases, to minimize the consumption rate of brightening agents. Additions should be one pint more or less — depending upon the effective concentration of purifier — per 500 gallons of bath per day. The purifier solution should be diluted with an ample amount of water (7 to 10 parts) before addition to the bath. Contrary to most common belief, copper is but little, if any, precipitated by a sulfide purifier and the only methods for removing this metal are to stir thoroughly with zinc dust or to electrolyze the copper out of the bath. Such treatments are usually only necessary where plating of brass with bright zinc is practiced. In event zinc dust is used, it may not be effective until washed with very dilute muriatic acid and rinsed well before stirring into the bath.

Bright zinc baths tend to change composition rapidly because of the chemical attack upon anodes when the bath is idle and, on the other hand, because of low anode efficiency during continuous operation in barrel lines. Yet for uniformly efficient production speed and deposit quality, the zinc content should remain relatively constant, especially with respect to ratio of total sodium cyanide to zinc metal. The decrease in efficiency of the bath with rise in this ratio is very marked. The net result of this is that every bright zinc bath must be checked frequently for zinc metal, total sodium cyanide and caustic soda. This should be done daily, with appropriate additions made to compensate for changes in composition. When the trend of the changes is established, less frequent analysis may be sufficient.

Analysis of Bright Zinc Baths

The following simplified methods have been used for many years and are applicable to all bright zinc baths except those in which there is a large accumulation of iron salts, for which correction can be made.

Reagents

1. Ammonium chloride — hydrochloric acid solution.

Ammonium chloride C.P.	150 grams
Hydrochloric acid C.P.	200 milliliters
Distilled water	to 1 liter

2. Sulfide solution consists of 15% sodium sulfide (crystal) in water.
3. Standard potassium ferrocyanide solution.
   Weight out exactly 33.0 grams potassium ferrocyanide crystals C.P. ($K_4Fe(CN)_6 3H_2O$) and 6 grams sodium sulfite. Dissolve in distilled water and bring to exactly 1 liter. Standardization is not necessary but may be made for greatest accuracy.
4. Uranium acetate — saturated solution in water.
5. Potassium iodide — 10% solution of potassium iodide C.P. in water.
6. Standard silver nitrate solution.
   Weigh out exactly 26 grams silver nitrate C.P. and dissolve in distilled water. Add 12.5 ml. nitric acid C.P. to above, then water to exactly 1 liter. Standardization is not necessary.
7. Sodium cyanide — 10% solution of sodium cyanide C.P. in distilled water.
8. LaMotte sulfo-orange solution — from *LaMotte Chemical Products Co.*, Baltimore, Md.
9. Standard sulfuric acid.
   To about 500 ml. distilled water in a volumetric flask, add exactly 26.5 ml. C.P., sp. gr. 1.84, concentrated sulfuric acid from a burette. Dilute with distilled water to 1 liter. Do *not* add water to sulfuric acid. Standardization may be made for greatest accuracy but is not essential for simple plating bath control.

Zinc Metal

1. Filter about 50 cc. of zinc solution sample.
2. Pipette exactly 1 ml. of the filtered bath into a 100 cc. beaker. (Use suction, *not* by mouth.)
3. Add about 20 cc. of ammonium chloride-hydrochloric acid solution. *Caution* — This reaction liberates poisonous hydrogen cyanide gas. Carry out only under hood or other ventilation.
4. Boil for several minutes still under ventilation.
5. Add 50 cc. distilled water and 1 drop sulfide solution.
6. Boil until sulfide odor is no longer detected.
7. Titrate hot with standard potassium ferrocyanide solution, using uranium acetate in spot plate as external indicator.
   No. of ml. Ferrocyanide solution used = oz. gal. zinc as metal.

Total Sodium Cyanide

1. Pipette (not by mouth, use rubber bulb) exactly 1 ml. sample of plating bath into 125 ml. Erlenmeyer flask.
2. Dilute to about 50 ml. with distilled water.
3. Add 5 ml. Ammonium Hydroxide and 10 drops 10% Potassium Iodide Solution.
4. Titrate with Standard Silver Nitrate Solution to first permanent opalescence.
   No. of ml. Silver Nitrate Solution × 2 = oz. gal. total sodium cyanide.

Caustic Soda

1. Pipette (not by mouth, use rubber bulb) exactly 5 ml. plating solution into 75 ml. Erlenmeyer flask.
2. Add 10 ml. 10% sodium cyanide solution and 8-12 drops of LaMotte Sulfo-Orange Indicator.
3. Titrate with Standard Sulfuric Acid Solution to color change from orange to yellow.

   No. of ml. Sulfuric Acid Solution = oz./gal. Caustic Soda.

The correction of zinc baths unavoidably entails a better understanding of chemical calculations than do most plating baths. Addition of zinc cyanide ($Zn(CN)_2$) also adds an equivalent amount of cyanide, or addition of zinc oxide (ZnO) also adds an equivalent amount of caustic soda (NaOH). The simplest way to regard these equivalents is as follows:

(a) 1 oz./gal. $Zn(CN)_2 \equiv$ 0.56 oz./gal. Zinc
also $\equiv$ 0.84 oz./gal. NaCN

(b) 1 oz./gal. ZnO $\equiv$ 0.8 oz./gal. Zinc
also $\equiv$ 1.0 oz./gal. NaOH

For 1 oz./gal. Zinc to be added, we must add—

$$\frac{1}{0.56} = 1.8 \text{ oz./gal. Zinc cyanide (from (a))}$$

or $\frac{1}{0.8} = 1.25$ oz./gal. zinc oxide (from (b)).

If therefore the cyanide is correct but zinc metal and caustic soda are low, zinc oxide will raise both zinc and caustic soda. If the caustic soda is correct but zinc metal and cyanide are low, zinc cyanide should be added. On the other hand if caustic soda and cyanide are both correct, zinc carbonate may be used to add zinc to the bath.

Another consideration is that if zinc metal rises as the result of high anode efficiency or because anodes are left in the tank for a long period of time, the caustic soda equivalent also rises in the ratio of 1.2 oz./gal. caustic soda to 1 oz./gal. zinc metal. The reverse is also true, that caustic soda drops if zinc metal drops. This is readily seen from the following equations:

$$Zn + 2NaCN + 2H_2O \rightarrow Zn(CN)_2 + H_2 \uparrow + 2NaOH$$

and $Zn(CN)_2 + 2NaOH \rightarrow Zn \downarrow + O \uparrow + 2NaCN + H_2O$.

A simple consideration of the effect of relative anode and cathode efficiencies is shown as follows:

(a) Anode efficiency *greater* than cathode efficiency — Then NaOH and pH rise.

(b) Anode efficiency *less* than cathode efficiency — Then NaOH and pH fall.

Control of zinc baths is by analysis as given above and by plating tests by the Hull Cell to check for impurities and their effect upon deposit quality. Plating tests are of value in still or automatic plating and show the various effects of changes in cyanide to zinc ratio and caustic soda contents. They tend, however, to give somewhat different results in barrel baths unless the test plates are properly interpreted. In this case, brightening agents tend to produce streaked deposits on the test plate which are unnoticed in barrel plating with the usual rotational agitation.

One minor point frequently observed is blistered deposits, even with correct bath compositions. This may usually be completely eliminated by addition of .01 to .05 oz./gal. of sodium hydrosulfite sprinkled directly on the bath surface and stirred into solution to convert any metallic brightener or chromium to the reduced state. This should not be dissolved in water before addition.

Plating Over Cast Iron

One serious limitation to bright zinc plating is its inability to plate readily over cast iron, high carbon steel, and slightly smutty areas that are easily plated with cadmium. The use of a cadmium or copper flash is a simple answer but is a greatly added expense. Various methods of pretreatment of such work have been proposed, of which one of the following is usually applicable:

(a) Soak or tumble 15-30 minutes in a hot cyanide solution (NaCN 1 to 2 lb./gal.).

(b) Soak 15 minutes in caustic soda solution (NaOH 3 lb./gal.).

(c) Prepare surface by sand blast or other similar treatment to give a new, clean surface.

(d) Be sure that 4 to 6 oz./gal. of sodium carbonate are in the zinc bath — added if necessary.

It is frequently advisable to examine barrel plated work after 10 minutes plating time to determine if it is covered. Assuming that brightener is present and the bath composition is correct, work that is not completely covered in 10 minutes probably requires a tumble cleaning in a cyanide solution (8 oz./gal. NaCN) to remove smut and promote covering.

Many barrel zinc installations are troubled with gas explosions from hydrogen and oxygen being trapped inside the barrels as well as in the slight foam on the bath surface. These can be serious enough to actually burst panels from barrels, and in any event are annoying. Such explosions may be virtually eliminated by adding a small amount of a suitable anti-foaming agent to the bath to break up the gas pockets, and also by carrying the solution level very close to the top of the barrels so that there is little room for gases in the barrel and little opportunity for intermittent contact and consequent sparking between danglers and the work.

Zinc Bright Dips

Some of the most important work on zinc in recent years has been the development of the various proprietary and patented chromate dips, both for giving added protection and for improving the lustre of the deposit. For a great deal of the usual run of work, the zinc directly from both barrel and still work is very acceptable. If not, the still tank work may be dipped in the usual ¼ to ½% nitric acid solution with rinses before and after. If the work darkens in this dip, metallic impurities are present in small concentration. For maximum salt spray resistance, the patented chromate dips may be used that leave a colored or iridescent film. After such dips, the value of the dip is largely nullified if the dipped parts are heated to 150°F. or

(*Concluded on page 63*)

Rinsability and Buffering Action of Alkaline Cleaners

At the recent meeting in New York of Committee D-12 of the *American Society for Testing Materials* action was taken on several subjects of importance to the electroplating and metal finishing industry.

One of these actions was the proposal of a Tentative Standard for testing the rinsability of alkaline metal cleaners. Another action was the proposal of a similar Tentative Standard covering the determination of the buffering action of alkaline cleaners. A third action was the proposal of standard definitions for terms commonly used in describing cleaning operations.

These proposals have been submitted to the Society with the recommendation that they become Tentative Standards, in which case they would be assigned an A.S.T.M. Specification number and would be published and widely circulated in the A.S.T.M. books of Standards.

The proposed methods are being published in *Metal Finishing* with the suggestion that persons interested try the methods and suggest any changes, or make any comments, that will help the committee compile an authoritative and comprehensive standard. A.S.T.M. Standards are widely used throughout industry in the purchasing and testing of materials. It is therefore to the best interests of all of industry to see that such standards represent practices which will be fair to consumers and producers alike.

Any comments on these proposed specifications should be addressed to the Chairman of Committee D-12, *Mr. J. C. Harris, Monsanto Chemical Co.*, Nicholas Rd., Dayton 7, Ohio.

Proposed Definitions

LATHER:

The foam or froth when a detergent is agitated in water or other liquid.

FOAM:

A mass of bubbles formed on liquids by agitation.

SUDS:

The foam or lather generated on or in a detergent solution.

RINSE: (whether used as a verb or a noun)

Treatment with water or other solvent for the purpose of removing dirt and/or detergent.

EMULSION:

A suspension of fine particles or globules of one or more liquids in another liquid.

EMULSION CLEANER:

A composition which forms an emulsion capable of dissolving or suspending soil.

SOIL: (in reference to detergency)

Matter out of place.

DIPHASE METAL CLEANER:

A composition which produces two phases in the cleaning tank, namely a solvent layer and an aqueous layer, which cleans by solvent action and emulsification.

Proposed Methods of Testing for Rinsing of Cleaners

SCOPE

The ease and thoroughness of rinsing of a cleaning composition is a characteristic which can markedly affect the cleanliness of processed work. This test is designed to provide a reproducible laboratory means for demonstrating this characteristic value.

SPECIMENS

The test panels shall be 2 x 4 inches in size, the thickness being of relative unimportance, of ferrous or other metal agreed upon, whose condition and finish shall be specified. Duplicate panels shall be tested.

PRECLEANING MATERIALS

The following cleaning materials shall be made ready for removal of soil present on the metal surface prior to test:

1. A 250-ml. beaker containing 200 ml. of carbon tetrachloride or trichloroethylene at room temperature.
2. A 1-liter beaker containing 150 to 200 ml. of hot carbon tetrachloride or trichlorothylene, the degree of vaporization being controlled to permit vapor degreasing of the specimens when held in the beaker, or alternatively, a wash bottle containing either of these solvents at 25 to 30° C.
3. A 250-ml. beaker of either anhydrous methanol or isopropanol at 50° C.
4. A 250-ml. beaker of distilled water at 50° C.
5. A 250-ml. beaker of redistilled acetone at room temperature, and
6. A small swab of fresh absorbent cotton placed in each of the beakers.

PRECLEANING TECHNIQUE

The test specimens shall be cleaned as follows immediately prior to use in the test:

1. Immerse the test specimens in the beaker of carbon tetrachloride or trichloroethylene and immediately swab the surfaces of the individual specimens thoroughly, using clean forceps to hold both the cotton swab and the test specimen.
2. After the swabbing of each specimen is completed, shake off excess solvent and either transfer the specimen to the vapor degreasing bath long enough to observe the vapor completely covering and condensing on the specimen, or thoroughly wash the specimen with a stream of fresh solvent from the wash bottle.
3. Swab the specimens separately in the beaker of alcohol and shake free from excess alcohol.
4. Transfer the specimens to the beaker of distilled water. Swab carefully and shake free from excess water.
5. Immerse the specimens separately several times

in the beaker of acetone, shake free from acetone, and place them in a beaker, spacing the specimens for maximum exposure of surface area. Permit to air dry.

RINSABILITY TEST

Submit the precleaned panels to the following procedure:

1. *Solution Concentration*

a. In the absence of the manufacturer's recommendations, the specimens shall be tested in a cleaner solution of the volume prescribed in Paragraph (2) and at solution concentrations of 0.25, 0.5, 1.0, 4.0, and 8.0 per cent by weight from stock solutions which shall be freshly prepared in 2000-g. quantities. If the cleaner is not soluble to the extent noted in the stock solutions indicated, a weighed quantity of the cleaner shall be transferred to a graduate and made up to volume.

Some cleaners may contain rosin, or rosin soap, and a boiling period of 30 minutes will be necessary.

b. In case the manufacturer's recommendations are available, the test shall be made at the following relative concentrations (based on the average concentrations suggested), recording the percentages these represent:

One half the concentration recommended,

At the concentration recommended, and

Twice the concentration recommended.

2. Immerse the panels for five minutes in a container of the cleaning bath at the recommended temperature of operation, or if these are not available at 70° C.

3. Remove panels, suspend flat at an angle of 45° and allow to dry. As soon as fully dry rinse by Step 4.

4. Suspend the panel in about 1 liter of distilled water at 70° ± 20° C. for three minutes, withdrawing the panel slowly once each minute. Repeat this process with a fresh sample of distilled water at 70° C.

5. Remove panels and allow to dry at an angle of 45° as before.

6. As soon as dry observe for any evidence of residue.

7. Add a drop of USP alcohol to the panel surface, allow to evaporate and observe for any evidence of a white deposit.

8. Immerse the panel in running tap water, remove and observe for water break.

9. Report presence or absence of residue by observation from (6) and by the alcohol drop observation (7). Report presence or absence of water break.

Proposed Test for Buffering Action

SCOPE

Buffer action is the resistance of a solution to change in pH. In metal cleaning, buffering capacity refers to the ability of an alkaline solution to absorb acidic material without marked change in pH. Buffer Index may be defined as the milliliters of 0.5 N-hydrochloric acid required to decrease the initial pH to one of the following buffer ranges agreed upon by the purchaser and the producer: A. From initial pH of solution to pH of 12.0. B. From 12.0 (or initial if between 11 and 12) down to 11.0. C. From 11.0 down to 10.0.

PROCEDURE

Prepare 500 ml. of a solution of 3.75 g. (1 oz./gal.) of the cleaner in distilled water.

Transfer 100 ml. of solution at 25° C. ± 1° C. to a 400 ml. beaker.

Following the "Tentative Method for Determination of the pH of Aqueous Solution with a Glass Electrode," ASTM Designation E70-46T with the high pH (low sodium-error) electrode, record the initial pH.

Additions of 1.0 ml. of 0.5 N HCl are made. The solution is brought to equilibrium after each acid addition and the pH recorded. Further 1 ml. additions of the acid are made and the corresponding pH values are recorded. Acid additions are terminated at a pH of 9.

The curve for pH versus aliquots of 0.5 N HCl is plotted.

The Buffer Index is calculated as follows:

Buffer Index = ml. 0.5 N acid to reduce pH to 10.

or

Buffer Index = A. ml. 0.5 N acid to reduce initial pH to 12.0
B. ml. 0.5 N acid to reduce pH from 12 to 11
C. ml. 0.5 N acid to reduce pH from 11 to 10.

BRIGHT ZINC PLATING

(*Concluded from page* 61)

higher. Therefore baking of parts after a chromate dip (e.g. to relieve hydrogen embrittlement, to dry or to bake lacquers) should be avoided. Maximum lustre of zinc, where desired, is obtained usually by a two-dip series of baths (proprietary), the first being the chromate dip followed by an alkaline "leach" dip.

There are indications that a chromate bright dip without the leach provides a resistant zinc surface that can be plated directly with chrome. However, this has not been proved as yet in production and is therefore not a recommended procedure in the present stage of development.

Hydrogen Embrittlement

Bright zinc produces some hydrogen embrittlement which is relieved by baking at a fairly high temperature. Provided steps are taken to avoid embrittlement prior to plating, including acid pickling not to exceed 30 seconds and reverse current cleaning, baking after plating at 375° to 400°F. for two to ten hours suffices to restore ductility on all but steel of unusually high hardness. Darkening sometimes occurs upon baking. This can be traced to one or more sources, i.e., inadequate rinsing after plating, insufficient cleaning before plating (if work is badly scaled or rusty, use sand blast cleaning instead of a long pickling time), or presence of metallic impurities in the bath. Evaluation of brightening agents should also include tests to insure that deposits produced in their presence do not darken upon baking.

The difficulties encountered in bright zinc plating should be very few, provided care is exercised to follow the fundamental principles of regular control analysis, susceptibility of the bath to contaminants, and scrupulous cleanliness.

Ventilation and Operation of Open-Surface Tanks

American Standard Safety Code Z 9.1-1951

THIS standard prescribes the best-known methods of carrying out open-surface tank operations, such as pickling, cleaning, plating, dipping, etc. with maximum protection to the life and health of workers. It also serves as a guide to the manufacturers and designers of exhaust systems used in connection with such operations. This Standard is a revision of, and replaces "*American Standard for Safety in Electroplating Operations*" Z9.1-1941.

Complete copies of the Standard may be obtained from the *American Standards Association*, 70 East 45th St., N. Y. 17, N. Y. at 75 cents per copy.

This Standard was developed under the sponsorship of the American Industrial Hygiene Ass'n., the American Society of Heating and Ventilating Engineers, and the National Ass'n. of Fan Manufacturers by a committee made up of members from 25 interested organizations, including the American Electroplaters Society.

The following pages give the more essential provisions of the Standard.

Classifications of Open-Surface Tank Operations

Open-surface tank operations shall be classified into 12 classes, numbered A-1 to C-4, inclusive.

Class is determined by two factors: *(a)* hazard potential designated by a letter from A to C, inclusive, and *(b)* rate of gas, vapor, or mist evolution designated by a number from 1 to 4 inclusive (*i.e.*, B-3).

Hazard Potential

Hazard potential is an index, on a scale of from A to C, inclusive, of the severity of the hazard associated with the substance contained in the tank because of the toxic or explosive nature of the vapor, gas, or mist produced therefrom. The relative toxicity is measured in terms of the Hygienic Standard of the gas or vapor in air in parts by volume of the gas or vapor in a million parts by volume of air (ppm) or of the mist in air in micrograms of mist per cubic meter of air (μg/cu m). The relative explosion hazard is measured in terms of the open-cup flash point (flash point) of the substance in the tank in degrees Fahrenheit. The Hygienic Standard and flash point of a number of substances commonly used in tanks are in Table I-A. Where the tank contains a mixture of liquids, the Hygienic Standard of the most toxic component (*i.e.*, the one having the lowest ppm or μg/cu m) shall be used except where such substance constitutes an insignificantly small fraction of the mixture.

Hazard potential shall be determined from Table I with the value indicating greater hazard being used (*i.e.*, A takes precedence over B or C; B over C).

Rate of Gas, Vapor, or Mist Evolution

Rate is a numerical index, on a scale of from 1 to 4, inclusive, both of the relative capacity of the tank to produce gas, vapor, or mist and the relative energy with which it is projected or carried upwards from the tank. Rate is evaluated in terms of *(a)* the temperature of the liquid in the tank in degrees Fahrenheit; *(b)* the number of degrees Fahrenheit that this temperature is below the boiling point of the liquid in degrees Fahrenheit; *(c)* the relative evaporation of the liquid in still air at room temperature in an arbitrary scale—fast, medium, slow, or nil (see Table I-A); and *(d)* the extent that the tank gases or produces mist in an arbitrary scale—high, medium, low, and nil. Boiling points and relative evaporation of a number of substances commonly used in tanks are in Table I-A. (Also see Table II Note *(b)*.) Gassing depends upon electrochemical or mechanical processes, the effects of which have to be individually evaluated for each installation. (See Table 2 Note *(c)*.)

Rate shall be determined from Table II, with the lowest numerical value being used.

Table I
Determination of Hazard Potential

Hazard Potential	Hygienic Standards		Flash Point
	Gas or Vapor (See Table I-A)	Mist (See Tables I-A, B, C)	(See Table I-A)
A	0-100 ppm	0-100 μg/cu m	under 100 F
B	101-500 ppm	101-500 μg/cu m	100-200 F
C	over 500 ppm	over 500 μg/cu m (μg = micrograms)	over 200 F

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Table 1-A

Table of Flash Point, Boiling Point, Relative Evaporation, and Suggested Hygienic Standard of Substances Encountered in Tank Operations

This is not a part of the American Standard Safety Code for Ventilation and Operation of Open-Surface Tanks, Z9.1-1951, but is included to assist in the use of the standard.

	Suggested Hygienic Standard (1)	Deg F Flash Point (2)	Deg F Boiling Range (2)	Relative Evaporation (3)
Acetaldehyde	B	—17	70	*
Acetone	B	0	134	Fast
Acrolein	A	....	127	*
Acrylonitrile	A	32	173	*
Amyl acetate (pure)	B	77	300	Slow
Amyl acetate (iso)	B	92	290	Slow
Amyl alcohol-n	A	100	280	Slow
Aniline	A	168	363	*
Benzene (benzol)	A	12	176	Fast
n-Butanol	A	100	243	Slow
2-Butanone	B	30	176	Fast
n-Butyl acetate	B	72	260	Medium
Butyl cellosolve	B	141	340	Nil
Carbon disulfide	A	—22	114	Fast
Carbon tetrachloride	A	None	170	Fast
Cellosolve	B	104	275	Slow
Cellosolve acetate	A	124	313	Slow
Chloroform	A	None	142	*
Cyclohexane		1	176	Fast
Cyclohexanol	A	154	322	Nil
Cyclohexanone	A	147	313	Nil
Cyclohexene	B	21	181	*
o-Dichlorobenzene	A	151	354	Nil
1-1 Dichloroethane	A	39	134	*
1-2 Dichloroethane	A	70	181	Fast
1-2 Dichloroethylene	B	43	141	*
Dichloroethyl ether	A	131	352	Nil
Dichloromethane	B	None	104	*
Dimethylaniline	A	145	379	*
Dioxane	A	54	214	*
Ethyl acetate	B	24	171	Fast
Ethyl alcohol	C	55	173	Fast
Ethyl benzene	B	59	277	*
Ethyl ether	B	—49	95	*
Ethyl silicate	A	125	334	*
Ethylene chlorohydrin	A	140	264	*
Ethylene oxide	A	<20	51	*
Gasoline (Benzine)	B	< 0	100-400	*
Heptane	B	25	208	*
Hexane	B	—15	156	*
Kerosene	B	100-165	306-405	Nil
Mesityl oxide	A	87	266	Medium
Methyl acetate	B	14	140	Fast
Methyl alcohol	B	52	147	Fast
Methyl bromide	A	None	40	Fast
Methyl butanone	A	....	199	*
Methyl cellosolve	A	105	255	Nil
Methyl cellosolve acetate	A	132	289	Nil
Methylcyclohexanone	A	118	325	Nil
Methylethyl ketone	(see Butanone)			
Methyl formate	A	—2	90	*
Methyl iso-butyl ketone	A	73	244	Medium
Monochlorobenzene	A	85	270	Medium
Monofluorotrichloromethane	C	None	75	Fast
Mononitrotoluene	A	223	460	*
Naphtha (coal tar)	B	100-110	300-400	*
Naphtha (V.M.&P.)	B	20	212-320	Fast
Nickel carbonyl	A	140° Explosive	110	*
Nitrobenzene	A	190	412	*
Octane	B	60	257	*
Pentane	C	—40	97	*
Pentanone	B	60	216	*
iso-Propyl acetate	B	40	194	Fast
iso-Propyl alcohol	B	53	181	Fast
iso-Propyl ether	B	—18	156	*
Stoddard solvent		110	300-400	Nil
Styrene monomer	B	90	295	*
1,1,2,2-Tetrachlorethane	A	None	295	*
Tetrachloroethylene	A	None	249	*
Toluene (toluol)	B	40	232	Medium
Toluidine	A	188	392	*
Trichloroethylene	B	None	189	*
Turpentine	A	95	300	Slow
Vinyl chloride	B	20	57	*
Water	C	None	212	Slow
Xylene, ortho	B	63	291	Medium

*Substances in the above table for which no relative evaporative data are available, may be assigned an evaporation rate from the following approximate criterion which was set up after an examination of existing data.

Average Boiling Point	Rate
200 F to 275 F	Fast
up to 200 F	Medium
275 F to 350 F	Slow
above 350 F	Nil

Notes:

(1) These values have been arranged in accordance with Hazard Potential Classification shown in Table 1.

(2) Most of the flash point and boiling point data are according to the National Fire Codes, Vol. 1, 1948. Since many varying flash points have been reported, the flash points recommended for general use have been shown. Where information was not available in the National Fire Codes, the following sources were consulted: Properties of Flammable Liquids, Gases, and Solids, Industrial and Engineering Chemistry, Vol. 32, No. 6, 880; Handbook of Chemistry and Physics, 30th Edition, 1947; and ASTM D92-24, ASTM D268-31T.

(3) Relative evaporation rates derived from A. K. Doolittle (Industrial and Engineering Chemistry, **27**, 1169) in the following manner:

Complete evaporation at room temperature	Rate
0- 3 hrs	Fast
3-12 hrs	Medium
12-50 hrs	Slow
above 50 hrs	Nil

Table 1-B

Table of Suggested Hygienic Standards for Toxic Mists, Fumes, Gases, or Vapors which May Emanate from Open-Tank Operations

(Not a part of 29.1 - 1951)

Substance	Suggested Hygienic Standard (1)
Acetic Acid	A
Acetic anhydride	A
Ammonia	A

(Continued on next page)

Table 1-B (Continued)

Arsine	A
Bromine	A
Carbon dioxide	C
Carbon monoxide	A
Chlorine	A
Chromic acid and Chromate as CrO_3	A
Formaldehyde	A
Hydrogen chloride	A
Hydrogen cyanide	A
Hydrogen fluoride	A
Hydrogen selenide	A
Hydrogen sulfide	A
Iodine	A
Nitrogen oxides (other than N_2O)	A
Phosgene	A
Phosphine	A
Phosphorus trichloride	A
Stibine	A
Sulfur chloride	A
Sulfur dioxide	A
Sulfuric acid	C

Notes:

This table includes water soluble gases, fume or vapor-producing substances which may be released as mists, gases, or vapors from aqueous solutions in open tanks. Water soluble substances listed in Appendix A fall into this category when used in aqueous solution. The rate of evaporation or generation of atmospheric contaminant will depend on the concentration and vapor pressure of the substance and on the temperature and activity (*i.e.*, current density in plating, mechanical stirring, etc.).

Table I-C

Table of Suggested Hygienic Standards for Toxic Metal Salts which May be Components of Mists Released from Open-Tank Operations

(Not a part of 29.1 - 1951)

Salts of	Suggested Hygienic Standard (1)
Antimony	B
Arsenic	B
Cadmium	A
Lead	B
Manganese	C
Mercury	A
Selenium	A
Tellurium	A

Note

(1) These values have been arranged in accordance with Hazard Potential Classifications shown in Table 1.

Table II

Determination of Rate of Gas, Vapor or Mist Evolution (a)

Rate	Liquid Temperature, F	Degrees Below Boiling Point	Relative Evaporation (*b*)	Gassing (*c*)
1	over 200	0- 20	Fast	High
2	150-200	21- 50	Medium	Medium
3	94-149	51-100	Slow	Low
4	under 94	over 100	Nil	Nil

Notes:

(*a*) In certain classes of equipment, specifically vapor degreasers, an internal condenser or vapor level thermostat is used to prevent the vapor from leaving the tank during normal operation. In such cases, rate of vapor evolution from the tank into the workroom is not dependent upon the factors listed in the table, but rather upon abnormalities of operating procedure. When operating procedure is excellent, effective rate of evolution may be taken as 4. When operating procedure is average, the effective rate of evolution may be taken as 3. Where operation is poor, a rate of 2 or 1 is indicated depending upon observed conditions.

(*b*) Relative evaporation rate is determined according to the method of A. K. Doolittle, Industrial and Engineering Chemistry, **27**, 1169, where time for 100-percent evaporation is as follows: Fast: 0-3 hours; Medium: 3-12 hours; Slow: 12-50 hours; Nil: more than 50 hours.

(*c*) Gassing means the formation by chemical or electrochemical action of minute bubbles of gas under the surface of the liquid in the tank and is generally limited to aqueous solutions. These bubbles form either on the surface of the work in the tank or on anode or cathode bars, if present, and are usually hydrogen or oxygen. Gassing should not be confused with boiling since gassing can occur in a cold liquid. Gassing may cause formation in the air over the tank of a mist of the liquid in the tank unless prevented by the use of means conforming to Section 10. Rate of gassing depends on rate of chemical or electrochemical action and therefore depends on the material treated and the solution used in the tank; and tends to increase with:

(1) The amount of work in the tank at any one time,

(2) The strength of the solution in the tank,

(3) The temperature of the solution in the tank, and

(4) The current density applied to the work in electrochemical tanks.

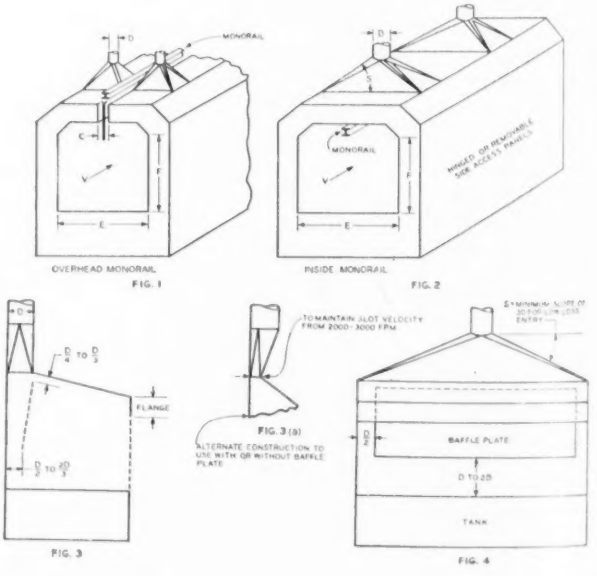
Since rate of gassing depends on factors additional to the liquid in the tank and its temperature, its prediction must be based upon observation of the process, laboratory, or pilot plant tests.

Examples of High, Medium, and Low gassing rate are:

High—Bright Dip (Nitric acid) of Brass and Bronze
Chrome Plating—Anodizing of Aluminum
Stripping Galvanizing in Acid Baths
Satin Finishing of Aluminum

Medium—Pickling of Steel
Alkaline Cleaning of Aluminum (Cold)
Electrolytic Strike—Battery Plate Forming

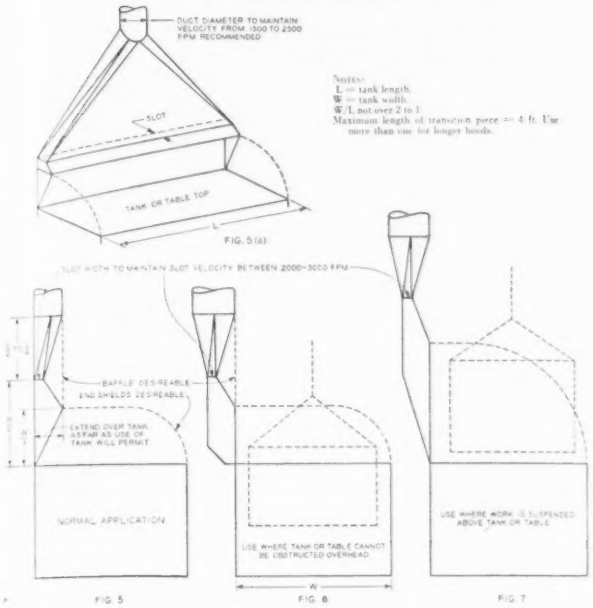
Low—Alkaline Cyanide Plating of Zinc
Phosphoric Acid Dipping of Steel
Tin Plating from Stannate Solution
Phosphate Treatment of Metal

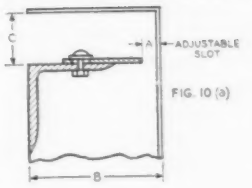


Notes: Where enclosure is impossible, use lateral or canopy exhaust.
D = pipe diameter usually sized for 1500-2500 fpm.
C, E, and F—Make only large enough to pass work and hanger.
Slopes (S) from 0 to 30 are permissible, but not recommended. Tapers to less than full width or length of hood also permissible.

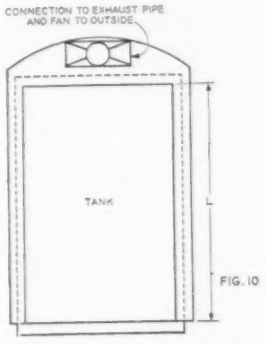
• Figure 1. Typical forms of Enclosing Hoods. See text for description.

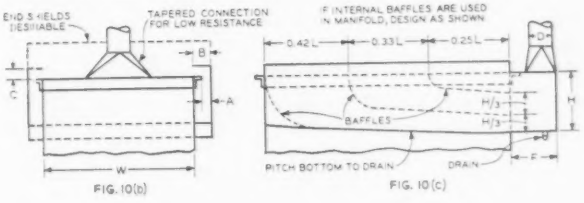
Figure 2. **Typical forms for lateral exhaust hoods for various sizes and types of processing tanks.**

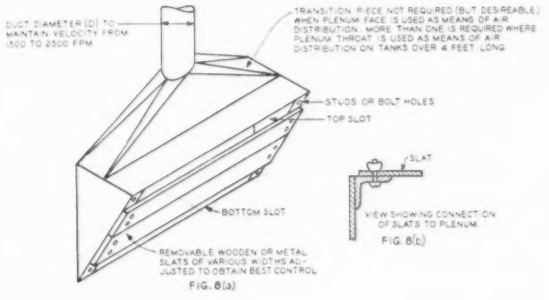


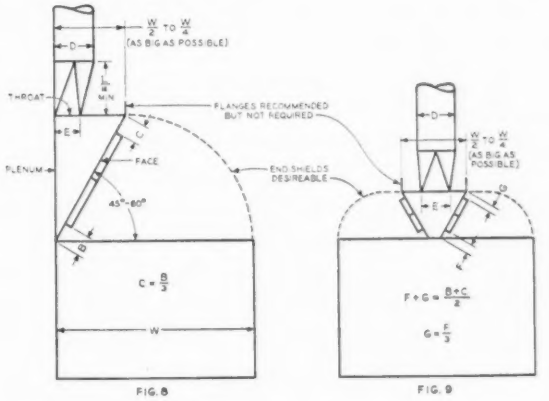


Notes:
Opening (C) may also be made adjustable.
D may exhaust upward or downward to suit plant conditions. Use more than one discharge duct on long tanks.
1. Slot velocity:
   Slot A: 1000-2000 fpm.
2. Slot velocity:
   Slot C: 500-1000 fpm.
3. B and H manifold dimensions as large as possible to give minimum velocity in manifold. Velocity should be not greater than maximum slot velocity.
4. F at least $2\frac{1}{2}$ B.
5. D = pipe diameter usually sized to maintain pipe velocity between 1500-2500 fpm.
6. Gas-heated tanks should have combustion chamber independently ventilated to outside.
7. Single slot alone on long side is permitted for tanks under 18 inches wide.
8. Use slots along both long sides for tanks between 18-42 inches wide.



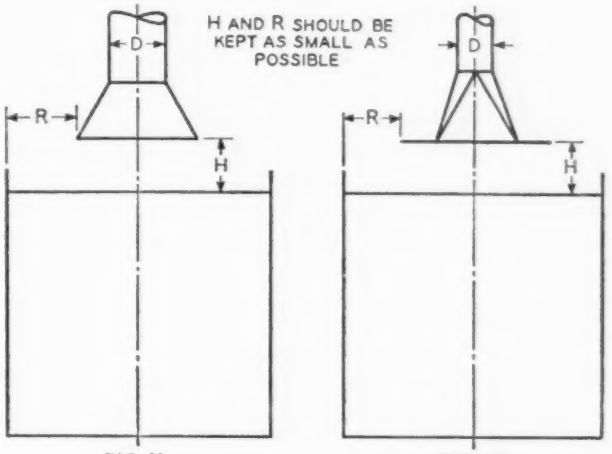


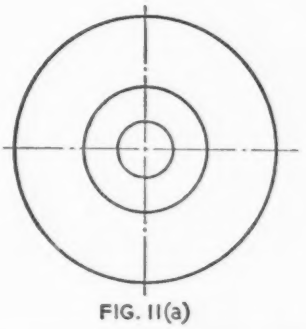


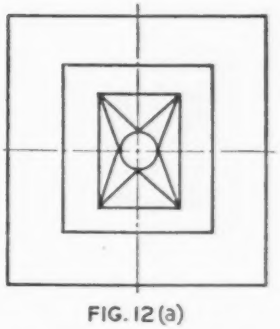


Design (a) Proportions	Means of Air Distribution	
	Plenum Throat	Plenum Face
E	0.05W-0.1W	0.1W-0.2W
B+C	0.1W-0.2W	0.05W-0.1W

(a) For construction shown on drawing.







Ventilation

Ventilation shall be by one of the following means:

(a) Enclosing hood exhaust,
(b) Lateral exhaust,
(c) Overhead canopy exhaust,
(d) General room (dilution) ventilation,
(e) Any other method providing equivalent ventilation.

Enclosing Hood Exhaust

All tanks exhausted by means of hoods, which *(a)* project over the entire tank, *(b)* are fixed in position in such a location that the head of the workman in all his normal operating positions while working at the tank in front of all hood openings, and *(c)* are completely enclosed on at least two sides, shall be considered to be exhausted through an enclosing hood and

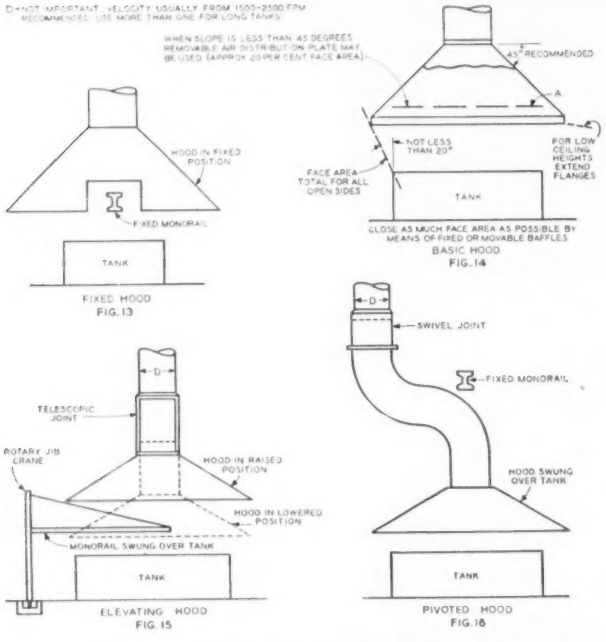


Figure 3. Typical forms of Canopy Hoods. See text for description.

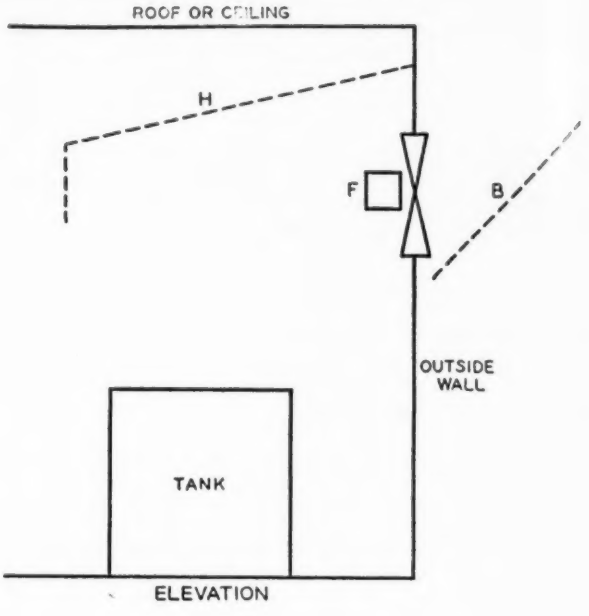


FIG. 17

Figure 4. Typical means of general room ventilation.

shall conform to the control requirements for enclosing hoods. Some typical forms of this type of hood are shown in Figure 1.

Lateral Exhaust

All tanks exhausted by means of hoods which do not project over the entire tank, and in which the direction of air movement into the hood or hoods is substantially horizontal, shall be considered to be laterally exhausted and shall conform to the control requirements for lateral exhaust. Typical forms of this type of hood are shown in Figure 2.

Overhead Canopy Exhaust

All tanks exhausted by means of hoods which project over the entire tank, and which do not conform to the definition of enclosing hoods, shall be considered to be overhead canopy hoods and shall conform to the control requirements for canopy hoods. Typical forms of this type of hood are shown in Figure 3.

General Room (Dilution) Ventilation

Tanks classified under "Hazard Potential" as Class A-4, B-4, C-3, and C-4 do not require the use of an enclosing hood, lateral exhaust, or canopy hood exhaust provided there is adequate general room ventilation by mechanical or natural means. One form of general room ventilation is shown in Figure 4.

Other Methods of Ventilation

Methods of ventilation in which air is supplied through ducts or pipes to the tank may be used as long as they do not adversely affect the exhaust or general room ventilation provided. Such methods include:

(a) Provision of unheated outdoor air at low supply velocity for the purpose of conserving heated room air during cold weather;

(b) Provision of compressed air at high pressure to nozzles directed at the exhaust hood opening to project and entrain air into the hood opening;

(c) Provision of either room air or unheated outdoor air at medium pressure to nozzles to accomplish either or both of the foregoing objectives; and

(d) Provision of a portion of the air exhausted from the tank to nozzles directed at the exhaust hood opening to project and entrain air into hood opening.

Table III

Minimum Control Velocity (Ft per Min —fpm) for Undisturbed Locations

Class (See Tables I and II	Enclosing Hoods		Lateral* Exhaust	Canopy Hoods	
	One Open Side	Two Open Sides		Three Open Sides	Four Open Sides
A-1, A-2, and B-1	75	100	100	125	175
A-3, B-2, and C-1	65	90	75	100	150
B-3 and C-2	50	75	50	75	125
A-4, B-4, C-3, and C-4	Adequate general room ventilation required.				

*See Table IV for computation of ventilation rate.

Table IV
Minimum Ventilation Rate of Cubic Feet of Air Per Minute per Square Foot of Tank Area for Lateral Exhaust

Required Minimum Control Velocity FPM (From Table 3)	Hood along one side or two parallel sides of tank when one hood is against a wall or baffle (Note *b*). Also, for a manifold along tank centerline (Note *c*). CFM per sq ft to maintain required minimum control velocity at following $\frac{\text{Tank Width (W)}}{\text{Tank Length (L)}}$ ratios. (Notes *a* and *d*).				
	0-0.09	0.1-0.24	0.25-0.49	0.5-0.99	1.0-2.0
50	50	60	75	90	100
75	75	90	110	130	150
100	100	125	150	175	200
150	150	190	225	260	300
	Hood along one side or two parallel sides of free standing tank not against wall or baffle				
50	75	90	100	110	125
75	110	130	150	170	190
100	150	175	200	225	250
150	225	260	300	340	375

NOTES:

(*a*) It is not practicable to ventilate across the long dimension of a tank whose ratio $\frac{W}{L}$ exceeds 2.0. It is undesirable to do so when $\frac{W}{L}$ exceeds 1.0.

(*b*) Baffle is a vertical plate the same length as tank, and with top of plate as high as tank is wide. If exhaust hood is on side of tank against a building wall or close to it, it is perfectly baffled.

(*c*) Use $\frac{W}{2}$ as tank width in computing when manifold is along centerline.

(*d*) Tank Width (W) means the effective width over which the hood must pull air to operate (*i.e.*, where the hood face is set back from the edge of the tank, this set back must be added in measuring tank width).

Control Requirements for Enclosing Hood Exhaust

CONTROL VELOCITY FOR ENCLOSING HOODS

For enclosing hoods, control velocity means the minimum velocity of air into the hood at any point in the plane of any opening in the enclosure and shall conform to Table III which stipulates the minimum control velocity for hoods of this type for Class A-1, A-2, A-3, B-1, B-2, B-3, C-1, and C-2 operations as classified in Tables I and II.

VENTILATION REQUIREMENTS

The quantity of air in cubic feet per minute necessary to be exhausted through an enclosing hood shall be not less than the product of the control velocity times the net area of all openings in the enclosure through which air can flow into the hood.

Control Requirements for Lateral Exhaust

CONTROL VELOCITY FOR LATERAL EXHAUST

For lateral exhaust, control velocity means the velocity of air towards the hood or hoods measured at the point at the top of the tank most remote from any hood opening or openings and shall conform to Table III which stipulates the minimum control velocity for hoods of this type for Class A-1, A-2, A-3, B-1, B-2, B-3, C-1, and C-2 operations as classified in Tables I and II.

VENTILATION REQUIREMENTS

The quantity of air in cubic feet per minute necessary to be laterally exhausted per square foot of tank area to maintain the required control velocity shall be determined from Table IV for all variations in ratio of tank width (W) to tank length (L). The total quantity of air in cubic feet per minute required to be exhausted per tank shall be not less than the product of the area of tank surface times the cubic feet per minute per square foot of tank area determined from Table IV.

Control Requirements for Canopy Hoods

For canopy hoods, control velocity means the minimum velocity of air into the hood at any point in the plane of any opening between any bottom edge of the hood and the top edge of the tank nearest thereto, and shall conform to Table 3 which stipulates the minimum control velocity for hoods of this type for Class A-1, A-2, A-3, B-1, B-2, B-3, C-1, and C-2 operations as classified in Tables I and II.

VENTILATION REQUIREMENT

The quantity of air in cubic feet per minute necessary to be exhausted through a canopy hood shall be not less than the product of the control velocity times the net area of all openings between the bottom edges of the hood and the top edges of the tank nearest thereto.

Minimum Control Velocity

Control velocities shall conform to Table III in all cases where the flow of air past the breathing or working zone of the operator and into the hood is undisturbed by local environmental conditions such as open windows, wall fans, unit heaters, or moving machinery. Where such disturbances to air flow occur, efforts should be made to eliminate or minimize them, and the hood should be so designed as to eliminate or minimize their influence. An evaluation should be made of the

Table V

Suggested Velocities to Compensate for Room Cross Drafts at Tank Level

Draft Definition	Add to Minimum Control Velocity for Undisturbed Location FPM *(a)*
Slight	25
Moderate	50
Strong *(b)*	100
Very strong *(b)*	200

Notes:

Where draft velocity can be measured, use measured velocity rather than tabular values.

(a) The direction as well as magnitude of the draft should always be considered in the choice of the value to add to the minimum control velocity. The addition of the full tabular value should be made only where the cross draft has its greatest possible adverse effect on the operation of the hood in question. Where the effect of a room draft is to assist the hood, as when it always blows toward the suction opening, it should be apparent that no addition to minimum control velocity would be required.

(b) It is preferable to use baffles to overcome strong drafts rather than use additional control velocity.

residual effect of such disturbances and the control velocity should be increased over that specified in Table III by an amount sufficient to overcome their effect. See Table V.

Spraying Operations Requiring the Use of Open-Surface Tanks

Spraying operations conducted over an open-surface tank, where the tank serves as a sump into which the sprayed liquid falls or drains for reuse through the sprays, are covered by this standard. Such operations shall be enclosed as completely as practicable and shall be ventilated to conform to the Control Requirements for Enclosed Hood Exhaust (see above). Either the inward air velocity into the enclosure shall be sufficient to prevent the discharge of spray into the workroom or mechanical baffles shall be provided to accomplish this result.

Control Means Other Than Ventilation

Tank covers, foams, beads, chips, or other materials floating on the tank surface so as to confine gases, mists, or vapors to the area under the cover or to the foam, head, or chip layer; or surface tension depressive agents added to the liquid in the tank to minimize mist formation or any combination thereof may all be used as gas, mist, or vapor control means for open-surface tank operations, provided:

(a) They do not introduce an explosion hazard due to accumulation of explosive gases or vapors under said cover or within or under said floating layer; and

(b) They give effective control throughout the entire operating cycle of the tank.

Where criteria *(a)* and *(b)* above are not met, sufficient ventilation should be provided to make the overall control of gas, mist, or vapor conform to these criteria.

System Design

MATERIALS OF CONSTRUCTION

For corrosive gases, vapors, or mists, hoods and ducts should be constructed of corrosion-resistant materials. A list of some materials is given in Tables VI and VII.

It is recommended that ducts be designed for a velocity of 1500 to 2500 fpm.

Table VI—Resistance to Corrosion of Materials Used for Hoods and Ducts

Classification / Approximate Service Life	See Footnote	Galvanized Iron	Black Iron	Stainless Steel	Monel	Lead Lining	Aluminum	Hard Rubber	Natural Rubber	Pressed Wood	Neoprene	Terne Plate	Buna S	Koroseal	Paint on Iron Galv or Black (Asphalt)	Hot, 180-200 F on Galv Iron (Asphalt)	3-Course Felted on Metal or Wood (Asphalt)	Painted Pressed Wood (Asphalt)	Paint (Phenolic Resin)	Bonded Plywood or Redwood (Phenolic Resin)	Baked, or Solid Cast Resin (Phenolic Resin)	Asbestos Cement Board or Tube	Vinylite Resin Type Paint	Vitrified Clay Pipe with Mastic Joints
E—Excellent .....Over 5 years S—Satisfactory .....2 to 5 years F—Fair .....½ to 2 years P—Poor .....6 months Combinations (EP) .....Indefinite rating	1														Asphalt				Phenolic Resin					
Acid, Chromic (Plating and Anodizing)		EP	EP	S		ES				SP	S	S			P				SF	P	EF			E
Acid, Hydrochloric		EP	P	E	S	F		E	E4		E	F	E	E	EF	S		S		F	EP	F	E4	E
Acid, Hydrofluoric		P			S				S						S						E			F
Acid, Nitric		P		E		E					E				FP	F					F		S	E
Acid, Oxalic (Anodizing)					E	S	E								S									E
Acid, Sulfuric		P	P	S5		E6		E	E7	P	E	S			EP	S	F		F	ES	E	E5	EP	E
Acid Dipping and Pickling (Horiz Ducts)															P	F	E							E
Alkaline Cleaner (Caustic 140-180 F)		EP	EP	E						S	E				ES			S			S	E		E
Alkaline Cleaning Solutions	2	E	E	E							E				E									E
Alkaline Plating (Cu, Cd, Ag)		EP	EP							E	S				ES			S			S	S	S	E
Plating and Anodizing (Horizontal Ducts)															P	S	E							E
Plating, Bright Nickel		SP	SP								S				E			S					S	E
Plating and Dipping (Vertical Ducts)		P													F					E				E
Tanning, Dressing, Dyeing, Bleaching Sol		S8							S9															E
Water, Boiling and Steam		EP	SP	E	E						E				ES	E						E	S	E
Decarbonizing Agents	3	E																						E
Degreasing Compounds; Organic & Mineral Sol		E	E																					E
Enamels and Lacquers (Coating & Dipping)		E	S																					
Fabric Impregnation		S																						
Salt, Supersaturated Solution 300-400 F		S	S																					E
Wire Insulation		S																						

NOTES: 1. Ratings are based upon collated field service reports. Indefinite ratings are given where reports are inconsistent due to varying operating conditions (such as dilution, exposure to weather, etc). Blank spaces denote insufficient information, not poor service. 2. Mild soaps, detergents, water soluble oils, 140-180 F. 3. Creosote oil, kerosene, ethylene dichloride. 4. To 20 percent: E; 50-70 percent, 150 F: S. 5. To 50 percent, plating: E; 20 percent anodizing, agitated 80 F: S. 6. To 50 percent plating: S; over 50 percent pickling, 20 percent anodizing: E. 7. 5-22 percent, 135-215 F pickling: S; plating, pickling, anodizing: E. 8. Except acid. 9. Acid.

Table VII—Resistance to Corrosion of Materials Used for Exhaust Fans

Classification / Approximate Service Life	Steel	Aluminum	Galvanized Steel	Cast Iron	Brass	Lead	Asphalt Paint	Vinyl Resin Paint	Red Lead Paint	Hot Asphalt	Phenolic Resin Baked Coating	Hard Rubber Lining	Soft Rubber	Neoprene	Everdur	Korolac	Pressed Wood	AISI 316	Acid Bronze
E—Excellent .....Over 5 years S—Satisfactory .....2 to 5 years F—Fair .....6 months to 2 years P—Poor .....6 months Combinations .....Variable performance																			
Acid Dipping, Pickling and Stripping	EP	S		E		E	SP		E		S	E	ES	E	E	F			P
Alkaline Cleaning	EF	S	E	E			EP				S	ES		E	E	F		E	
Anodizing	SF	S					E	E	E		E	E		E					
Coating—Enamel and Lacquer	E	E			E						S			E					
Decarbonizing	ES				E		P					E			E	F			
Degreasing and Metal Cleaning	ES		ES		E														
Hardening and Quenching	ES		ES																
Plating	EP	S		E			ES	S			ES	E	E	E					
Washing and Rinsing	EP	E		E			SP			S		E		E			F		

Note: Ratings are based upon collated field service reports. Forward curved fans are *not* recommended for open-tank ventilation service. Cleanout doors and bottom drains are recommended on all fans on open-tank operations. The deposits which build up on fan wheels and casings should be removed by regular cleaning. Repaint where any coating has been broken and removed.

Separation of Systems from Different Processes

Two or more operations shall not be connected to the same exhaust system where either one or the combination of the substances removed may constitute a fire, explosion, or chemical reaction hazard, either in the duct system or by drainage of condensate back into any tank.

Fans and Ejectors

The equipment for exhausting air shall have sufficient capacity to produce the flow of air required in each of the hoods and openings of the system.

The capacity required shall be obtained when the air-flow producing equipment is operating against the following pressure losses, the sum of which is the static pressure:

(a) Entrance losses into the hood;

(b) Resistance to air flow in branch pipe including bends and transformations;

(c) Entrance loss into the main pipe;

(d) Resistance to air flow in main pipe including bends and transformations;

(e) Resistance of mechanical equipment; that is, filters, washers, condensers, absorbers, etc., plus their entrance and exit losses;

(f) Resistance in discharge duct and weather cap. (Information of this nature may be found in *Fundamentals Relating to the Design and Operation of Exhaust Systems, Z9*, in its latest revision and in the Guide of the *American Society of Heating and Ventilating Engineers*. For information on specific equipment, consult equipment manufacturer.)

Fans

Fans shall have motors and bearings outside the air stream or otherwise be adequately protected from the substances being exhausted. Where the substance is corrosive, the impeller and housing should be of corrosion-resistant material or provided with a protective coating of rubber, a resin, or in the case of mildly corrosive fumes, acid resistant paint. Where the substance forms an explosive mixture with air, or otherwise presents a fire hazard, either the impeller shall be of nonferrous or nonsparking material, or the casing should be fabricated of, or lined with, such material, or both. Fans shall be located and arranged as to afford ready access for repairing, cleaning, and inspection. They shall be placed on solid foundations or firmly secured to substantial supports.

Ejectors

For certain types of installations, where the gas being handled is extremely corrosive, flammable, or explosive, it may be desirable not to have the gas passed through the fan. For this purpose, ejectors may be used.

Operation

Maintenance of Air Flow

The required air flow shall be maintained at all times during which gas, mist, or vapor is emitted from the tank and at all times the tank, draining, or drying area is in operation or use. At the end of every three months of operation, or after a prolonged shutdown period, the duct system shall be inspected for evidence of corrosion and the air flow checked. Deficient air flow shall be corrected. Any significant change in air flow shall require tests to determine the effectiveness of the ventilating system under operating conditions, as indicated by atmospheric contamination.

Discharge and Recirculation

The exhaust system shall, wherever possible, discharge to the outer air and shall terminate at a point from which the possibility of its effluent entering any building is at a minimum. Recirculation shall only be through a device for contaminant removal which will prevent the creation of a health hazard in the room or area to which the air is recirculated.

Make-Up Air

Air exhausted from any room shall be replaced by an equal volume of fresh air. The fresh air supply should enter the workroom in such a manner that no employee is subjected to a draft of air having a temperature of more than 10 degrees below the general temperature of the room or of a greater velocity than 200 fpm. The make-up air shall be uncontaminated. Where the quantity of make-up air required for any workroom having windows of normal construction exceeds the equivalent of two workroom air changes per hour, provision shall be made to supply all make-up air in excess of two air changes.

Personal Protection

All employees working in and around open-surface tank operations must be instructed as to the hazards of their respective jobs, and in the first aid procedures applicable to these hazards.

Clothing

All persons required to work on wet floors even where elevated platform gratings (duck boards) are used, shall be provided with rubber or other impervious boots or shoes, rubbers, or wooden-soled shoes sufficient to keep feet dry.

All persons required to handle work wet with a liquid other than water, or reach into any tank containing other than water, shall be provided with rubber or other impervious gloves of a length sufficient to prevent entrance of liquid into the tops of the gloves. The interior of gloves shall be kept clean. When in use, gloves should be tested daily for leaks.

All persons required to work in such a manner that their clothing may become wet shall be provided with such rubber or other impervious aprons, coats, jackets, sleeves, or other garments as are required to keep their clothing dry. Aprons shall extend well below the top of boots to prevent liquid splashing into the boots. Provision of dry, clean cotton clothing with rubber shoes or short boots and an impervious apron shall be considered a satisfactory substitute where small parts are cleaned, plated, or acid dipped in open tanks and rapid work is required.

Whenever there is danger of splashing, for example, when additions are made manually to the tanks, or when acids and chemicals are removed from the tanks, the employees so engaged shall be required to wear either tight-fitting chemical goggles of an approved type or an effective face shield. (See American Standard Safety Code for the Protection of Heads, Eyes, and Respiratory Organs of Industrial Workers, Z2-1938, or the latest revision thereof approved by the American Standards Association.)

Ointments

Proper ointments and protective creams are of value for the additional protection of the face and hands, but should not be used as a substitute for adequate ventilation or protective clothing.

Emergency Rinsing Water

Near each tank containing a liquid which may burn, irritate, or otherwise be harmful to the skin if splashed upon the worker's body, there shall be a supply of cold water from an approved source. The water pipe (carrying a pressure not exceeding 25 pounds) shall be provided with a quick opening valve and at least 48 inches of hose not smaller than $\frac{3}{4}$ inch so that no time may be lost in washing off liquids from the skin or clothing. (The use of deluge showers and eye flushes has been found satisfactory in cases where harmful chemicals may be splashed on parts of the body.)

Examination of Operators

Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chances of exposure to the chemicals are removed. Workers exposed to chromic acid shall have a periodic examination made of the nostrils and other parts of the body, to detect incipient ulceration.

Sanitation

Sufficient washing facilities, including soap, individual towels, and hot water, shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin on the basis of at least one basin or its equivalent with a hot water faucet for every ten employees. Shower baths should be available to such employees and their use encouraged.

Locker space or equivalent clothing storage facilities shall be provided to prevent contamination of street clothing.

First Aid

First aid facilities specific to the hazards of the operations conducted shall be readily available.

Special Precautions for Cyanide

Cyanide compounds and solutions are potentially dangerous in the presence of acids. Where a rinse tank containing traces of acid is used after a cyanide tank, the rinse tank should be ventilated. Where a rinse tank containing traces of acids is used before a cyanide tank, the cyanide tank should be ventilated. Where a rinse tank containing traces of cyanide is used before an acid tank, the acid tank should be ventilated. Where a rinse tank containing traces of cyanide is used after an acid tank, the rinse tank should be ventilated. Moreover, it is good practice to store cyanide salts in a locked cage, and the floor of this cage should be raised above any floor on which acid carboys are stored. Cyanide tanks should not be provided with drains or overflows which will allow the tank contents to mix with liquid drained from other tanks either on the floor or in floor drains.

Inspection, Maintenance, and Installation

Floors and platforms around tanks shall be prevented from becoming slippery both by original type of construction and by frequent flushing. They shall be firm, sound, and of design and construction to minimize the possibility of tripping.

Before cleaning the interior of any tank, the contents shall be drained off and the cleanout doors shall be opened where provided. All pockets in tanks or pits where it is possible for hazardous vapors to collect shall be ventilated and cleared of such vapors.

No unprotected person shall enter any drained tank for cleaning or inspection without first checking the breathing level of a man kneeling on the tank floor for any possible oxygen deficiency and for hazardous concentrations of gas or vapor. No person shall enter any such tank where an oxygen deficiency or hazardous gas or vapor concentration has been shown to exist without a respirator or supplied air suit suitable to protect him from the exposure (an air line respirator in the case of an oxygen deficiency; a supplied air suit

in the case of hazardous gases or vapors which may be absorbed through or cause dermatitis of the skin), a life line, and another person outside the tank to operate the life line.

Maintenance work requires welding or open flame where toxic metal fumes such as cadmium, chromium, or lead may be evolved, shall be done only with sufficient local exhaust ventilation to prevent the creation of a health hazard, or with approved respiratory protection. Welding or use of open flames near any solvent cleaning equipment shall be permitted only after such equipment has first been thoroughly cleared of solvents and vapors.

Steam pipes in or under the duckboard level, or under tanks, should be shielded against being splashed with solvents. Tank liquids should not be discharged on the floor but piped to the drain to prevent volatilization.

Sample Calculations

1. Boiling water in a 6 × 3-ft. tank in an undisturbed location with unbaffled lateral exhaust along the two long sides of the tank.
   - *(a)* From Appendix A for water: Suggested Hygienic Standard—1; flash point—none; boiling point—212 degrees; relative evaporation—slow.
   - *(b)* From Table 1: Hygienic Standard is C and flash point is over 200 F. Hazard potential is C.
   - *(c)* From Table 2: Liquid Temperature is over 200 degrees and liquid is 0 degrees below boiling point. Rate of vapor evolution is 1.
   - *(d)* From Tables 1 and 2: Hazard potential is C and rate is 1. Class is C-1.
   - *(e)* From Table 3: Minimum control velocity for lateral exhaust for Class C-1 operations in undisturbed locations is 75 fpm.
   - *(f)* from Table 4: Ratio of tank $= \frac{3}{6} = 0.5$. For a two-sided hood with no baffle, a required minimum control velocity of 75 fpm and a $\frac{W}{L}$ ratio of 0.5, minimum cfm per sq. ft. of 170 is required.
   - *(g)* Tank area = 6 × 3 ft. = 18 sq. ft.
   - *(h)* Minimum ventilation rate required = 170 × 18 = 3060 cfm (half through each side hood).
2. Methanol (methyl alcohol) at room temperature (68 F) in a 2 × 4-ft. tank with lateral ventilation from the one short side of the tank that is backed up to the wall. Cross draft of about 50 fpm present.
   - *(a)* From Appendix A for methyl alcohol: Suggested Hygienic Standard—B; flash point—52 degrees; boiling point—147 degrees; relative evaporation—fast.
   - *(b)* From Table 1: Hygienic Standard alone places it in hazard potential of B; flash point in hazard potential of A. Since A takes precedence over B, use hazard potential of A.
   - *(c)* From Table 2: Temperature alone places it in rate of 4; degrees below boiling point (147 − 68 = 79 degrees) places it in rate of 1. relative evaporation places it in rate of 1. Since lowest number must be used, use rate of evolution of 1.
   - *(d)* From Tables 1 and 2: Hazard potential is A and rate is 1, class is A-1.
   - *(e)* From Table 3: Minimum control velocity for lateral exhaust of Class A-1 operations in undisturbed locations is 100 fpm. Since a 50-fpm cross draft is present, design control velocity should be 150 fpm.
   - *(f)* From Table 4: Ratio of tank $= \frac{4}{2} = 2.0$. Tank hood is backed up against wall and is therefore baffled so that for required minimum control of 150 fpm and $\frac{W}{L}$ ratio of 2.0, minimum cfm per sq. ft. of 300 is required.
   - *(g)* Tank area = 4 × 2 ft. = 8 sq. ft.
   - *(h)* Minimum ventilation rate required = 300 × 8 = 2400 cfm.
3. Nickel plating tank at 140 F. Gassing rate low. Since this is a weakly acid aqueous solution, hazard potential is C. (See example 1.)
   - *(a)* From Table 2: Liquid temperature is at rate 3; degrees below boiling point (212 − 140 = 72 degrees) is at rate 3; relative evaporation is slow and therefore at rate 3. Since all rates are 3, use rate of evolution of 3.
   - *(b)* From Tables 1 and 2: Hazard potential is C and rate is 3; class is C-3.
   - *(c)* From Table 3: Adequate general room ventilation is required.
4. A mechanized chrome plating tank with work carried through the tank by overhead conveyor. Tank 15 × 2½ ft. enclosed on both long sides and top. Total open area into enclosure 25 sq. ft. Tank is at 110 F. Gassing rate high (chromic acid mist evolved). Aqueous solution. Hood opening protected from room drafts.
   - *(a)* From Table 1: Disregard Hygienic Standard and flash point for water. Use Suggested Hygienic Standard for chromic acid mist (from Appendix A1)—hazard potential is therefore A.
   - *(b)* From Table 2: Gassing is at rate 1. Therefore rate of evolution is 1.
   - *(c)* From Tables 1 and 2: Hazard potential is A and rate is 1. Class is A-1.
   - *(d)* From Table 3: Minimum control velocity for enclosing hood with two open sides for Class A-1 operation is 100 fpm. Since hood openings are protected from draft, no increase in this value need be made.
   - *(e)* Minimum ventilation rate required = 100 × 25 = 2500 cfm.
5. A 6 × 6-ft. canopy hood over a 4 × 4-ft. tank for surface treatment of aluminum stampings in caustic soda solution at room temperature. Moderate room cross drafts. Vertical height from tank top to bottom of hood—3 ft. Visual observation of proc-

(*Concluded on page 76*)

Electrodepositors' Technical Society Holds 1951 Convention

THE technical event of the year in the British metal finishing industry, the Annual Convention of the *Electrodepositors' Technical Society*, took place in April at Torquay, in Devonshire.

The program covered a wide range of papers of extreme technical interest, both theory and practice in electrodeposition being well-balanced. The papers included contributions from such well-known international authorities as *Dr. U. R. Evans*, of Cambridge University, *Professor Finch*, of London University, and *Professor Tolansky*. There was one American contribution from *Mr. R. M. MacIntosh*.

The complete list of titles and authors of papers are as follows:

(1) "*Studies in the Discontinuities of Electrodeposited Metallic Coatings — Pts. II and III*," by S. C. Shome and U. R. Evans.

(2) "*Some Factors Affecting the Rate of Diffusion of Hydrogen through Steel during Electrolytic Pickling*," by Bell, Metcalf and Sully.

(3) "*The Development of Tin-zinc Alloy Plating in the U. S. A.*," by R. M. MacIntosh.

(4) "*Electrodeposition of Bright Tin-nickel Alloy Plate*," by N. Parkinson.

(5) "*The Structure of Electrodeposited Tin-nickel Alloy*," by H. P. Rooksby.

(6) "*Some Applications of Interferometry to Examination of an Electrodeposited Film*," by Prof. S. Tolanosky.

(7) "*Electrodeposition of Nickel in the Bores of Tubes, using Insoluble Anodes*," by Hothersall and Gardam.

(8) "*Hard Chromium Plating of Large Cast Iron Roll*," by Wallbank and Airey.

(9) "*Crystal Growth in Metallic Electrodeposits*," by Prof. G. Finch.

(10) "*Electrodeposition on Aluminum — a study of the Zincate Process*," by G. L. J. Bailey.

(11) "*Inorganic Chromatography on Cellulose: some applications to the Analysis of Electroplating Solutions*," by Burstall, Kember & Wells.

(12) "*Observations on Electroplating in the U. S. A.*," by members of Specialist Productivity Team on Metal Finishing.

Abstracts of some of the more interesting contributions are appended. Complete papers and discussions will be available in a bound volume at an early date.

An interesting social program included a Civic reception by the Mayor, Mayoress & Corporation of Torquay, and the conference banquet, which took place on April 13th. A record number of applications were received from members and visitors, and there is little doubt that the convention was an outstanding success.

"*Electrodeposition on Aluminum: A Study of the Zincate Process.*"

By *G. L. J. Bailey*, Ph.D., D.I.C., F. Inst. P.

The observations of rate of formation and structure of zinc deposits, which are described, together with the results of adhesion tests on commercial purity aluminum in a number of zincate solutions, enable a tentative explanation to be offered for the adhesion of coatings applied using the zincate process. Reasons are also given for supposing that the condition of strongest adhesion is the condition for least incidence of corrosion failures.

Electron diffraction evidence on zinc deposits formed in dilute solutions shows that they are made up of single crystal "trees," unrelated in size to the aluminum crystal from which they start to grow. Such crystal nuclei must be relatively far apart, since the crystal size of the zinc deposit is large. From micrographic evidence it is seen that the deposit is extremely spongy, so that each single crystal probably consists of a number of branching dendrites with relatively large intervening spaces. These "trees," as they grow, eventually become interlocked, the degree of interlocking governing adhesion strength of the coating. When the aluminum surface is completely covered by lateral spreading from the nuclei the rate of deposition of zinc suddenly falls since further reaction with the

aluminum surface is impeded. Low temperature stoving to improve adhesion, commonly thought to result in alloying, is now thought to sinter and compact an initially porous zinc deposit.

To obtain, therefore, maximum adhesive strength in order to combat subsequently corrosion, it is essential that the aluminum surface should be covered entirely with the largest possible number of zinc crystals. Such deposits will be the thinnest and most compact of any, and attention must be given in growing these deposits to the conditioning treatment needed for particular materials, to the choice of the zincate solution composition and to the time of immersion best suited to produce the finest grain deposits on material conditioned in a given way.

"An X-ray Study of Tin-Nickel Electrodeposits."

By *H. P. Rooksby*, B.Sc., F. Inst. P.

An X-ray investigation of the crystal structure and textural propeties of tin-nickel alloy electrodeposits is described.

A meta-stable nickel arsenide type structure, similar to that of gamma dash Ni_3Sn_2, characterizes the alloy electrodeposit. The hexagonal structure cell constants $a_o = 4.15$ Å, $c_o = 5.10$ Å, $c/a = 1.23$ differ appreciably from established values for Ni_3Sn_2, and the differences result from the change in composition from Ni_3Sn_2 towards NiSn that is induced by the conditions of electrodeposition. The alloy deposit is stable up to 300°C, but decomposes on heating above this temperature.

A strongly market preferred orientation texture is found in bright tin-nickel electrodeposits, and an analogy with bright speculum is evident.

"The Electrodeposition of Bright Tin-Nickel Alloy Plate."

By *N. Parkinson*, M.Sc., A.R.I.C.

A process for the deposition of a new bright alloy coating of tin and nickel is described. The electrolyte contains stannous chloride, nickel chloride and fluorides, the preferred composition being stannous chloride, 50 g./l., nickel chloride 300 g./l., sodium fluoride 28 g./l., ammonium bifluoride 35 g./l.

At a working temperature of 65° C. and an average cathode current density of 25 amperes per sq. ft., bright plate is obtained over irregular objects at a current efficiency approaching 100%. The composition of the deposit is largely independent of variations in current density and temperature. Variations of 20-30% in the content of either metal in the electrolyte produce insignificant changes in the composition of the alloy deposited. The chief factor controlling the composition of the deposit is the total fluorine content of the electrolyte.

A qualitative study of factors affecting the brightness of the deposit has shown that the broadest bright plating range is obtained at high rather than at low temperatures and that the presence of free hydrofluoric acid and of an alkali metal ion (preferably sodium) is necessary for the best results.

The replenishment of the bath may be effected either by using alloy anodes or by employing separate tin and nickel anodes supplied at differing voltages. With separate anodes precautionary measures are necessary to minimize the effect of chemical reaction between the tin anodes and the electrolyte. The alloy plate is an intermetallic compound and consequently is fairly hard. It has a pleasing appearance and in some lights exhibits a faint rose-pink cast. The plate is extremely resistant to atmospheric tarnishing.

"Electrodeposition of Nickel in the Bores of Tubes, using Insoluble Anodes."

By *A. W. Hothersall* and *G. E. Gardam.*

Smooth deposits of nickel having good mechanical properties may be built up to a considerable thickness on the bores of tubes by the use of an insoluble anode which is made or coated with lead. A nickel sulphate boric acid solution free from chloride is circulated through the tube and its composition is maintained by the continuous or periodic addition of nickel hydroxide in a finely divided condition; 0.03 to 0.04 grammes of nickel hydroxide must be added per minute for each ampere of depositing current. The success of the process depends upon proper attention to detail. In particular, to the finish of the surface of the tube, to the diameter, material and straightness of the anode and to the correct rate of flow of the solution in relation to the size of the tube and the current density of deposition. Nickel deposits 0.05″ in thickness have been built up inside tubes 6 ft. in length and initially 4″ in diameter. The deposits normally have a diamond hardness number of approximately 200, an ultimate tensile strength of approximately 30 tons per sq. inch and an elongation of approximately 30%.

"Studies in the Discontinuities of Electrodeposited Metallic Coatings—II."*

By *S. C. Shome* and *U. R. Evans.*

Two methods have been developed for measuring the total uncovered area, "a", of a plated specimen (most earlier methods furnish merely the number of pores). One depends on the total iron passing into solution when a nickel-plated specimen is joined to copper-gauze of area so large that any further increase in area causes no appreciable increase in the rate of passage of iron into the liquid; the other method depends on the current flowing between the copper and the specimen under similar conditions. A straight line is obtained when log a is plotted against t^2, where t is the time of plating at constant current density, but not when it is plotted against t or t^2. The result — viewed in the light of an earlier theoretical discussion — suggests that deposition starts from pre-existing nuclei, and that if the initial number of nuclei can be increased, the porosity remaining after any given time of plating should be reduced. This may represent the theoretical justification for the practice of starting plating with a "strike bath" at high current density. Other rational measures for minimizing porosity, suggested from Part I of the paper, include the use of a bath having a high value of d_η/dI (where η is the polarization at current density I), the choice of a metallic basis which is smooth and clean and the use of a bath free from suspended matter.

**Part I of this series was presented to the last E.T.S. Conference—1950.*

"Studies in the Discontinuities of Electrodeposited Metallic Coatings—III."

By *S. C. Shome* and *U. R. Evans.*

The theoretical principles underlying porosity tests in metallic coatings on steel are discussed. The reagent chosen for a reliable test should not attack the coating, should be highly conducting and should contain a cathodic stimulator, thus shortening the testing period. It should also help precipitation of iron in visible form, thus enabling the pores to be counted. Neither the ferroxyl, hot-water nor salt-spray test entirely fulfill these requirements.

A new method, suggested by *J. N. Agar* and based on a sodium chloride solution containing a small amount of hydrogen peroxide, has been found promising. Rust spots appear readily on a thin nickel-plated steel specimen immersed in this mixture. The hydrogen peroxide enhances the corrosion of the steel by stimulating the cathodic reaction and also converts ferrous ions at the pores to visible rust spots; there is less attack on the nickel than in the ferroxyl test.

The potential of nickel-plated steel specimens moves in the cathodic direction as the thickness of the coatings increases. The change of potential is small in the presence of sodium chloride or ferroxyl solution, but is marked if the sodium chloride solution also contains hydrogen peroxide. The observations confirmed the conclusions arrived at in Part 2 of this paper.

"Some Applications of Interferometry to the Examinations of an Electrodeposited Film."

By *Prof. F. Tolansky.*

A brief survey is made, showing how multiple-beam interferometry can offer a means of studying electrodeposits. The applications described include the examination of surface contour, which under certain conditions may be extended to curved surfaces. Some interfometric observations on micro-hardness indentations with a pyramid can show much of interest concerning the distortion of the surface surrounding the identation. This distortion indicates the true hardness of the electrodeposit, which cannot otherwise be determined by normal indentation methods due to the extreme thinness of the film.

A precise measurement of deposit thicknesses may also be made, by interferometric methods, especially for thicknesses below one micro-inch. The use of interferometry for special investigations is examplified by an experiment which was performed to determine how closely a thin tin-nickel deposit contoured the underlying brass sub-strate.

"Inorganic Chromatography on Cellulose: Some Applications of the Analysis of Nickel Plating Baths."

By *F. H. Burstall, N. F. Kember* and *R. A. Wells.*

A cellulose column separation process is described, which enables a number of metals to be extracted together from a nickel plating solution. It is possible to extract the metals one at a time or at least in small groups by a suitable choice of solvent. A process has already been described for the analysis of a chloride solution of nickel steels, which, applied to a cobalt-nickel plating solution, will enable the cobalt to be extracted separately.

Chromatographic methods are simple and reasonably rapid in operation, and while cellulose has so far proved the most satisfactory adsorbent the choice of a solvent must be determined by experiment in the light of the mixture of metals known to be present in the solution.

Principle factors involved in the mechanism of separation are:

a) selective solution and complex formation.
b) partition of metal and salts between solvent and water in the cellulose adsorbent, and
c) preferential adsorption of metals by the cellulose.

The relation of these factors in separation methods is not yet fully understood, but this does not affect the useful application of the method to mixtures of salts in solution.

VENTILATION AND OPERATION OF OPEN-SURFACE TANKS

(*Concluded from page* 73)

ess shows medium rate of gassing and formation of caustic soda mist. No suggested Hygienic Standard for caustic soda mist but by comparison with equally irritating acid mists a hazard potential of B is indicated.

(a) From Table 2: Medium gassing places rate of evolution as 2.

(b) From Tables 1 and 2: Hazard potential of B and rate of evolution of 2 places operation in Class B-2.

(c) From Table 3: Minimum control velocity for canopy hood with four open sides is 150 fpm. Add 50 fpm for cross draft to yield 200 fpm. (See Appendix G.)

(d) Open area for each of four sides is equal to the mean length of side: *i.e.*,

$$\frac{(\text{length of tank} + \text{length of hood})}{2} \times$$

height of area through which air flows: *i.e.*

$$\sqrt{(\text{vertical height})^2 + (\text{overhang})^2}$$

The area of all four sides is:

$$(4)\ \frac{(6+4)}{(2)}\sqrt{(3)^2 + (1)^2} =$$

$$4 \times 5 \times 3.16 = 63.2 \text{ sq. ft.}$$

(e) Ventilation rate required $= 200 \times 63.2 =$ 12,640 cfm.

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Removing Chrome from Nickel Solutions

Question: How can we remove chromium contamination from our nickel bath?

D. F.

Answer: Chromium may be precipitated from nickel solutions by adding a small amount of lead carbonate powder and thoroughly stirring the bath. The precipitated lead chromate is then allowed to settle, the solution filtered into a clean tank, and the main tank cleaned out. The purified nickel solution must then be dummy plated to remove any excess of lead which may have dissolved in the bath. After the dummying treatment the solution can then be filtered back into the main tank, after first adjusting the pH to the proper value.

Brass Plating Thickness

Question: We are brass plating zipper parts over a bright zinc plate. We get a satisfactory finish at first, but after about a week the brass color disappears, leaving the white zinc color exposed. Can you tell us what is causing this trouble and how it can be overcome?

L. G. H.

Answer: The answer to this problem undoubtedly lies in the thickness of brass plating applied over the bright zinc. Very thin deposits of brass or copper (less than .00005") can be absorbed into the zinc plating to form a copper-zinc alloy. The only way to overcome this problem is by applying a much heavier coating of brass, at least .0003", or by flash nickel coating before brass plating. The brass plate will not be absorbed into the nickel, which thus acts as a barrier layer between the base metal under the nickel and the brass plating.

Zinc Plating Over Cast Iron

Question: Can you explain why you can't plate cast iron in cyanide zinc solutions? This problem has come up in our plant, and although we know that it cannot be done we have no explanation for it. Any information you can give us will be appreciated.

W. C.

Answer: Zinc can be plated over cast iron, but it requires special procedures. The difficulty revolves around the low hydrogen overvoltage of zinc in cyanide solutions. A cadmium "flash" is often used, after which the regular cyanide zinc bath will deposit a good coating. Another suggestion is a "flash" from an acid zinc bath, followed by plating in the cyanide solution. A flash in an alkaline tin bath containing low metal and high alkalinity is also good. Other methods include preliminary pickling in molten caustic baths and special proprietary electropickling steps. *Diggin* made a very comprehensive report on the whole subject of plating on iron castings in the May 1943 issue of *Metal Finishing*, which gives complete details of the above methods and several others.

Bright Dipping Old Cadmium Plated Parts

Question: We have a large number of cadmium plated special tools that have been lying on the shelves for several years, and the cadmium plate is now rather dingy looking. We would like to brighten this up preferably by wiping on some material that will do the job. As the parts are assembled with bearings and grease inside them, they cannot be dipped. Is there some material that we could use to do this job that would not harm the tools? Any help you can give us will be appreciated.

K. A. C.

Answer: There are a number of solutions that might be used, but they all require dipping the parts for best action. It might be possible for you to carefully brush or wipe them on and get the desired results, but it would be necessary to remove all oil and grease from the surfaces to be cleaned. This could be done using any one of the usual solvents, such as naptha, benzine, etc. After brushing on the chemicals, they would have to be thoroughly rinsed off the tools to prevent any corrosion later on. Names of firms who can supply such bright dips are being sent to you.

Eliminating Bright Dipping Fumes

Question: In bright dipping solutions it is not always possible for us to arrange adequate ventilation. Can you suggest any means whereby we could absorb the fumes in our own plant without the need for the customary ventilation systems to the roof or outside of the building?

H. I. C.

Answer: In bright dips containing nitric acid, it is possible to suppress the mist that arises due to the effervescence of the bath during the dipping operation, but there is no way that the poisonous brown fumes of nitrogen oxides can be eliminated. The only solution to this problem is adequate ventilation. The same is true for hydrochloric acid baths of high strength-the fumes of HCl can be minimized, but not completely suppressed. Sulfuric acid solutions give off only hydrogen, which while not poisonous, usu-

ally contains sufficient impurities to give it an objectionable odor requiring ventilation also. Mist suppressors, similar to those used in chrome plating solutions, will help somewhat, but there is no adequate substitution for good ventilation.

Using Impure Nickel Anodes

Question: What would be the problems involved in using nickel metal for anodes if the nickel were not pure? We have had some available to us but the seller said they were not pure enough for nickel plating work.

D. P. F.

Answer: The problems would depend on the nature of the impurities, of course. These impurities would dissolve in the bath, and could cause all kinds of trouble. Frequent dummying would be necessary, as well as other methods of bath purification, to eliminate streaking, black deposits, etc. Dummying would remove any lead, copper, or zinc; iron and chromium could be chemically precipitated and filtered out of the bath. How frequently this would be required depends on the amount of impurities in the anodes, but at any rate the cost of operation of such a bath would be far in excess of the usual operating costs, not to mention the production headaches.

Black Film on Tin Anodes

Question: How can the black film that forms on tin anodes be removed most easily?

F. T.

Answer: Black anodes are caused by too high a current density. They can be cleaned by dipping the anodes in a strong solution of hydrochloric acid, rinsing, and placing back in the tank. A recent article in *Metal Finishing* by *Lowenheim* discusses the operation and maintenance of tin anodes in great detail, and gives methods for overcoming this and other anode problems in tin solutions.

Plating Britannia Metal

Question: We are having trouble in plating Britannia metal in that the plating has a tendency to peel and lift off. We wonder if some special cleaning procedure is not required for this metal, and would appreciate any help you can give us on this problem.

W. E.

Answer: The usual problem in plating peeling from Britannia metal is in too harsh cleaning methods. Too many platers make the mistake of trying to use the same cleaning baths for Britannia as they use for steel or brass, with usually disastrous results. Britannia requires only the mildest cleaners, such as a 4 oz./gal. solution of T.S.P. The bulk of the oil or grease must be removed in a vapor degreaser or solvent type cleaner. After a soak period in the mild alkaline cleaner, a short cathodic treatment, followed by a short reverse-current treatment (not over 10 seconds) should be sufficient. It is also suggested that a dip in 5% fluoboric acid be used after rinsing from the alkaline cleaner and before plating, in place of the usual sulfuric or hydrochloric acid dip.

Removing Oil Films From Baths

Question: We have had some difficulty in operating our dull nickel solution, in that a thin film of oily matter seems to have accumulated on the surface of the bath. How can this film be removed most economically?

Answer: The oily film was no doubt formed from overhead dripping or the use of oil-laden compressed air lines. Most of the film can be removed by skimming the bath, and the final amounts may be removed by placing thin sheets of absorbent wrapping tissue on the surface of the bath. These sheets will soak up the oil and can be lifted off the surface. The treatment should be repeated until the surface is completely free of oily films.

Recently Granted Patents
in the Metal Finishing Field

PATENTS

24 Hour Patent Service

Copies of these or any other Patent will be mailed within 24 hours of receipt of order and payment of 50 cents per Patent. Give Number, Title, or general subject matter. PATENT PROCUREMENT SERVICE, BOX 4127MF, Washington 15, D. C.

Ventilated Buff

U. S. Patent 2,526,420. *V. L. Richards, assignor to Canadian Hanson and Van Winkle Co.*

A ventilated buffing wheel assembly comprising a plurality of annular buffing sections of flexible material arranged side by side; a spacing and supporting hub for each of said sections comprising a disc having a central aperture to receive a spindle and a plurality of perforations radially disposed with respect to said aperture to form axially extending air passages and a plurality of spaced slots cut into the outer periphery of said disc and extending inwardly, and rings attached between the spaced slots to opposite sides of said disc adjacent the outer periphery, one of said rings having an axially extending flange centering and supporting said annular buffing section, the other ring being flat, the depth of each ring from the outer edge to the inner edge thereof extending inwardly a smaller distance radially of said disc than said spaced slots and thus defining with said spaced slots radial air passages; and means clamping said sections and hubs for rotation with a spindle as a unit, said means having perforations therethrough to permit ingress of air.

Coloring Treatment for Zinc Alloys

U. S. Patent 2,527,828. *E. A. Kruszynski and B. F. Smith, assignors to Carter Carburetor Corp.*

The method of producing a visible, colored protective coating on a surface of metal of the class consisting of zinc and a zinc base alloy, which comprises immersing the metal surface for from 5 to 20 seconds in a heated solution containing per liter of solution from 70 to 130 grams of chromium nitrate, about 13 grams of oxalic acid, about 5 ml. of phosphoric acid, and the balance water.

Contact Polishing Wheel

U. S. Patent 2,527,554. *A. E. Kimball, assignor to Minnesota Mining & Mfg. Co.*

A contact wheel for use in abrading operations comprising a plurality of coaxial circular sections of resilient material in sheet form of substantial thickness and means for retaining said circular sections in cooperative relation with each other to form a body having a cylindrical surface, said circular sections being arranged to provide one or more continuous annular chambers within the body of said wheel, certain of said circular sections being provided with transverse apertures communicating with said continuous annular chambers.

Surface Treatment for Plating on Stainless Steel

U. S. Patent 2,528,717. *C. Batcheller.*

The method of plating the surface of a stainless steel alloy containing at least 7%, by weight, of chromium which comprises forming in and integral with said surface an adherent, dark colored film of oxide by merely immersing said steel in a solution containing, by weight—

	Percent
Water	35 to 55
Free sulfuric acid (1.84 sp. gr.)	15 to 55
Chromic acid	2 to 20
Iron sulfate	0.01 to 10
Chromium sulfate	0.01 to 10
Minor quantities of other sulfates, bisulfates and impurities	Balance

and thereafter electroplating said oxide filmed surface with copper in an alkaline electrolyte.

Gun Bluing Solution

U. S. Patent 2,527,232. *W. G. Scroxton.*

A composition of matter for the bluing of a ferrous article such as a gun barrel, composed of a dilute aqueous solution containing one per cent each of sulfuric acid and copper chloride, about four per cent of selenious acid and the remainder water.

Copper-Tin Alloy Plating With Single Anodes

U. S. Patent 2,528,601. *F. A. Lowenheim, assignor to Metal & Thermit Corp.*

Method of electroplating a copper-tin alloy from a plating bath with which only a single anode circuit is used, said bath containing an aqueous solution of alkali metal cyanide and alkali metal hydroxide and having copper and tin dissolved therein, which comprises regenerating the bath by adding copper stannate thereto, and plating said alloy from said bath.

Electroforming Precision Fine-Mesh Screens

U. S. Patent 2,529,086. *H. B. Law, assignor to Radio Corp. of America.*

The method of forming a fine mesh screen which comprises forming grooves of a predetermined screen pattern in the surface of a hard ceramic plate, cathode sputtering a very thin layer of metal consisting essentially of about 1 part bismuth, 7 parts palladium, and 25 parts gold over said surface and in said grooves, removing the metal from the ungrooved portion of the surface, electroplating from a neutral or acid bath a substantial thickness of another metal over the sputtered metal in said grooves and stripping the formed screen from said plate.

Buffing and Polishing Compositions

U. S. Patent 2,529,722. *A. E. Chester, assignor to Poor & Co.*

A buffing and polishing composition

(*Continued on page* 112)

pH and BUFFERING

In the following tables will be found pH values for various acids and bases commonly used in metal cleaning and plating operations.

[pH VALUES OF ACIDS]

Hydrochloric acid	Normal	0.1	Formic acid	0.1 N	2.3
	0.1 N	1.1	Acetic acid	Normal	2.4
	0.01 N	2.0		0.1 N	2.9
Sulfuric acid	Normal	0.3		0.01 N	3.4
	0.1 N	1.2			
	0.01 N	2.1	Carbonic acid	(saturated)	3.8
Phosphoric acid	(ortho) N	0.5	Hydrogen sulfide	0.1 N	4.1
	0.1 N	1.5	Arsenious acid	(sat.)	5.0
	0.01 N	2.4			
			Hydrocyanic acid	0.1 N	5.1
Oxalic acid	0.1 N	1.6			
Tartaric acid	0.1 N	2.2	Boric acid	0.1 N	5.2
Citric acid	0.1 N	2.2			

[pH VALUES O F COMMON BASES]

Sodium Hydroxide	Normal	14.0	Ammonium hydroxide	Normal	11.6
	0.1 N	13.0		0.1 N	11.1
	0.01 N	12.0		0.01 N	10.6
Potassium Hydroxide	Normal	14.0	Potassium cyanide	0.1 N	11.0
	0.1 N	13.0			
	0.01 N	12.0	Sodium sesquicarbonate	0.1 N	10.1
Sodium orthosilicate	0.1 N	12.8			
Sodium metasilicate	0.1 N	12.6	Borax	0.1 N	9.2
Trisodium Phosphate	0.1 N	12.0			
Sodium carbonate	0.1 N	11.6	Sodium bicarbonate	0.1 N	8.4

BUFFER MIXTURES

The following table gives some of the more common buffer mixtures, and the range of pH over which they offer maximum buffering capacity. While the zone of effective action will vary with concentration of the buffer mixture, for concentrations of 0.1 Molar the general average will be ± 1.0 from the values in the table.

Glycocoll — Sodium Chloride — Hydrochloric acid	2.0
Potassium acid phthalate — Hydrochloric acid	2.8
Primary Potassium Citrate	3.7
Acetic acid — Sodium Acetate	4.6
Potassium acid phthalate — Sodium hydroxide	5.0
Secondary Sodium Citrate	5.0
Potassium acid phosphate — Disodium phosphate	6.8
Potassium acid phosphate — Sodium hydroxide	6.8
Boric acid — Borax	8.5
Borax	9.2
Boric acid — Sodium hydroxide	9.2
Sodium bicarbonate — Sodium carbonate	10.2
Disodium phosphate — Sodium hydroxide	11.5

ZINC PLATING

For ULTIMATE BRILLIANCE And Best Results

Use ROHCO PRODUCTS!

ROHCO 100 AND 303 ZINC BRIGHTENERS

ROHCO 100 Barrel Brightener imparts brilliance to zinc plating that is almost unbelievable until observed. It exhibits high covering power so that recesses, usually unplated, are easily covered with a substantial thickness of deposit. ROHCO 303 Still Brightener gives unusually bright deposits that offer ideal surfaces for bright dipping to even greater lustre or for conversion coatings by chromic acid treatment. Minimizes consumption of bright dips. Also exhibits high covering power so that recesses are easily plated. The cost of ROHCO 100 and ROHCO 303 is far less than would be anticipated for the many advantages realized in uniformly highest quality, maximum production, and minimum labor costs.

ROHCO ZINC PURIFIER

ROHCO Zinc Purifier keeps heavy metals precipitated and harmless to the bath. Used in the amount of only one pint per 500 gallons per day, either barrel or still, it minimizes consumption of zinc brighteners. Its cost is almost negligible.

ROHCO NO-FLASH

ROHCO No-Flash is used principally for barrel plating but may also be used for still plating. At a cost that is negligible, this product eliminates the hazard and nuisance resulting from gas explosions in zinc plating.

ROHCO

OTHER ROHCO PRODUCTS

NO-CRO-MIST • HULL CELL TEST • ROHCO 20XL CADMIUM BRIGHTENER RINS-AID

R. O. HULL & CO., INC.
1301 Parsons Court
Rocky River 16, Ohio

Canada: **Armalite Company, Ltd.**
Toronto 6, Canada

"YOUR PLATING IS BEST WITH THE HULL CELL TEST"

JUST PIN THIS COUPON TO YOUR LETTERHEAD!

R. O. HULL & CO., INC.
1301 Parsons Court, Rocky River 16, Ohio

Gentlemen:

SEND
- .....Gal., Liquid, ROHCO 100 BARREL ZINC BRIGHTENER
- .....Gal., Liquid, ROHCO 303 STILL ZINC BRIGHTENER
- .....Gal., Liquid, ROHCO ZINC PURIFIER
- .....Lbs., Powder, ROHCO NO-FLASH

Name.....

Company.....

Street Address.....

City.....Zone.....State.....

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Sprayed Neoprene Coatings

The Atlas Mineral Products Co., Dept. MF, Mertztown, Pa.

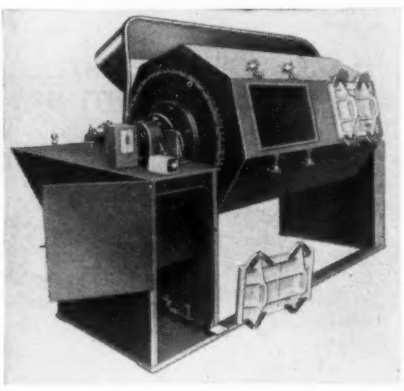
Atlas Mineral Products, a pioneer in the development of liquid Neoprene coatings, has now improved its product so that it is readily sprayed and is fast-curing at ordinary temperatures, it is claimed. This product is based on Du Pont Neoprene, and possesses the chemical resistance for which Neoprene is noted.

This product, which is available both as a high solids spraying solution and a trowel cement, is sold under the name of Neobon and is being used throughout industry to protect against abrasion and corrosive solutions. Neobon is available in experimental quantities and unlimited quantities with proper priority ratings.

Variable-Speed Tumbling Barrels

D. J. Murray Mfg. Co., Dept. MF, Wausau, Wisconsin.

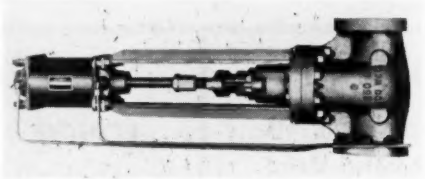
Made in both constant and variable speeds, the new Murco tumbling barrels have both motor and operating mechanism totally enclosed. The only exposed parts are the controls and magnetic reversing starter, making them completely safe in operation, as a limit switch permits operation only when the hood is closed. Illustrated is the 7½ h.p. constant-speed model that operates at 25 r.p.m. The variable speed 7½ h.p. model has speeds from 8 r.p.m. slow speed to 25 r.p.m. high speed, with an infinite range of speeds in between to meet operating conditions. Speed changes may be made while the barrel is in motion . . .no cumbersome changes of belts or pulleys. The foot operated hydraulic brake at floor level stops the barrel in any position, facilitates loading and unloading, and prevents accidental dumping of loads.



The new Murco tumbling barrels are also made in 5 h.p. constant and variable speed models and 3 h.p. constant and variable speed models.

Valve Actuators

Ledeen Manufacturing Co., Dept. MF, 1602 So. San Pedro St., Los Angeles 15, Cal.



Designed for the operation of gate valves, plug valves, dampers, diaphragm valves, butterfly valves and sluice gates, is a line of valve actuators just introduced by this firm.

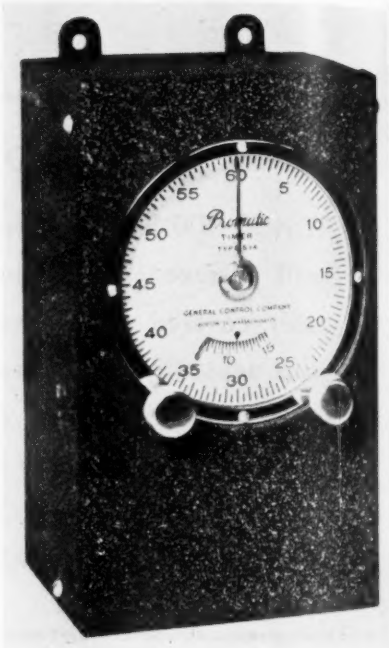
Ledeen valve actuators are basically cylinders equipped with brackets, valves, controls, and couplings to make them suitable for almost any type of operation required. They can be adapted to any make, size, and type of valve; to operate against any line pressure; to work on any fluid medium, and with any pressure available. They can be arranged for on-and-off service, or for positioning service.

Synchronous-Motor Timer

Product Acceptance Company, Dept. MF, 357 Everett St., Boston 34, Mass.

This firm has designed a new synchronous-motor timer for accurate control of a wide variety of timed operations.

This type SY "Promatic" Timer can be used for all time periods between ½ second and 24 hours. It actuates five s.p.d.t. load contacts independent of the timer-control circuits. There are two separate solenoids — one operates the clutch and timing mechanism, the other actuates the load contacts. The timer automatically resets for each new cycle.



Sturdily mounted in a cast frame, long life is assured through a unique "O" ring-drive assembly which eliminates gears. The pre-set interval and the elapsed time are both clearly visible on the 3-⅜" diameter dial.

The timer is available for either 115 or 230 volts a.c. Outside dimensions are 4½" wide, 4-⅛" deep, and 8" high, including terminal strips.

Stop-Off and Masking Coating

Western Coating Co., Dept. MF, 85 W. Union St., Pasadena 1, Calif.

This firm announces their new Maskcoat No. 2 for quick masking jobs by immersion dipping. The coating is claimed to give sharp and distinct stop-off lines, for use in masking critical areas for plating. The coating can be easily stripped off, and is claimed to be non-contaminating to all common pla-

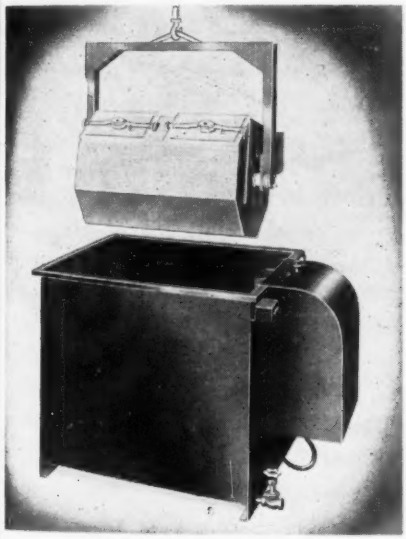
ting solutions, including bright nickel.

In use, the part to be masked is dipped into the melted coating material, and is ready for trimming in a matter of a few seconds. The coating material can be remelted for use over again, so that its use is very economical. The firm also manufactures the necessary heating pots for melting and holding the melted coating. The firm also has a 100%-solids rack coating compound for either brushing or dipping application, to be followed by fusing. For complete details about these compounds, write to the above address.

Submerged Finishing Machine

Almco, Div. of Queen Stove Works, Dept. MF, Albert Lea, Minn.

This new addition to the Almco Supersheen line of finishing equipment will enable manufacturers to enjoy the benefits of advanced barrel finishing. Though the standard barrel models will handle an extremely wide range of parts, this new submerged unit is particularly useful in the processing of



heavy parts and large soft-metal parts. The cushioning effect which results from the complete immersion of the barrel lessens the impact between large parts to such an extent that nicking and scratching are kept to a minimum, it is claimed. Another adaption of this new submerged barrel is in the processing of smaller parts requiring the utmost in color and micro-inch finish.

The perforated steel drum revolves in an open tank of liquid. The drum is loaded with work parts and the abrasive chips or metal shapes. Various liquid compounds are used in the tank depending on whether the operator is

CASE HISTORIES

Actual Reports Available on Request

Eliminating Peeling on Chrome Plated Admiralty Brass Antennas, and Cutting Electrocleaning Costs in Half

Parts Cleaned: Admiralty brass tubing after buffing and prior to nickel and chrome plating.

Former Method: Direct and reverse current cleaning, using an alkaline cleaner.

Present Method: Parts from automatic buffing machines are charged in the electrocleaning tanks with Magnus 25, plus a small amount of Magnus NX. Direct cleaned for one minute and reverse cleaned for 15 seconds, tubing is then rinsed, hot and cold, given a muriatic acid dip, cold rinsed, then bright nickel and chrome plated.

Result of Operation Change: Peeling, which was a serious trouble with the former method, has been virtually eliminated. The cleaning is done by #25, the NX being added to provide added wetting action and faster, more thorough rinsing.

Instead of dumping the cleaning tanks every week, they operate the Magnus 25 solution for two weeks.

This firm also cleans steel parts for cadmium plating. After the successful results on the above mentioned operation, they tried Magnus 25 with NX on these steel units. Direct current cleaned for one minute and reverse cleaned for one minute, parts are then hot rinsed, acid dipped, cold rinsed and cadmium plated. These solutions also last twice as long as when the former cleaner was used.

Magnus 25 is only one of the many specialized Magnus Cleaners developed for electrocleaning. One of these will clean your parts better and more economically, whatever metal or combination of metals they may contain . . . whatever your local water conditions may be . . . and whatever type of cutting, drawing or buffing compounds you use. A test run with samples of your parts in the Magnus Laboratory will quickly determine the Magnus product best suited to your needs. Why not use this service—without obligation?

For information write Magnus Chemical Co., 11 South Ave., Garwood, N. J. In Canada—Magnus Chemicals Ltd., Montreal 36, Que. Service representatives in all principal U. S. cities.

to burnish, polish, clean, descale or rustproof.

This model is for use alone or "in-line" for multiple operation processing. For instance, an in-line installation consisting of six tanks would include a combination cleaning and deburring operation, rinse, descale, and deburr at one time, rinse, burnish, hot rinse, or the rust-proofing step. In such an arrangement, the drum is loaded with parts and abrasive chips and is moved from one tank to another, eliminating the need for removal of the mass from the drum until the process is completely finished. A special Almco Supersheen separating screen is available for installation at the end of the "line."

Full information about this new barrel can be obtained by writing.

Black and Olive Drab Corrosion-Resistant Finishes for Zinc

United Chromium, Inc., Dept. MF, 100 East 24nd St., New York 17, N. Y.

United Chromium has added two new compounds to their line of Unichrome Dip Compounds for decorative and protective finishing of zinc. The new additions are identified as Compounds 1060 and 1070, and are used to produce corrosion-resisting, chromate-type conversion coatings that are black or olive drab in color.

These compounds are claimed to yield lustrous finishes that meet the corrosion-resistance requirements of most specifications for chromate-type conversion coatings on zinc. The finishes are produced on a metal-conserving deposit of 0.0002 to 0.0005 inches of zinc. The process is a simple dipping one which can be carried out at room temperature.

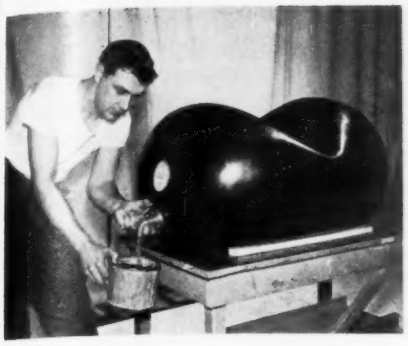
In addition to these newly developed compounds, other Unichrome Dip Compounds are available for producing clear finishes on zinc plate and also yellow iridescent coatings on zinc plate or zinc die castings. The compounds used for producing the clear finish with an appearance similar to chromium are Unichrome Dip Compounds 95 and 98. The important difference between these compounds is their speed of reaction on zinc, the slower reacting Compound 98 being ideal for finishing with full automatic equipment. Dip Compound 95, which is used at a dilution of 1:7 for producing the clear finish, can be further diluted from 1:20 to 1:80 to produce a yellow iridescent finish. This finish can be employed to increase the corrosion resistance of zinc or to prepare zinc for painting.

Collapsible Rubber Drum for Shipping Chemicals

United States Rubber Co., 1230 6th Ave., New York 20, N. Y.

This firm has developed a new 55-gallon synthetic rubber-fabric drum, suitable for shipping liquids, which can be collapsed after emptying, is returnable and reusable. Limited quantities are already being produced for essential uses in the petroleum and liquid chemical fields.

The new drum should effect sizable savings in return shipping costs, since more than 2,500 collapsed drums can



be shipped in a standard railroad box car that would hold only 300 rigid drums.

Experimental tests indicate that the new drum will be suitable for the shipment of oils, greases, fats, acids, paints, emulsions, soaps, dry powders and a variety of pharmaceutical and industrial chemicals. It is also believed to be practical for transporting liquids by air for the military and for dropping liquids by parachute to ground troops.

It is made of Ustex cord fabric, impregnated with synthetic rubber and molded in one piece. (Ustex cord is a strong, low stretch cotton textile made by U. S. Rubber Co.) The result is a tough, flexible, synthetic rubber-fabric drum approximating the size of a regular barrel or drum. It is equipped with simple yet effective fittings for filling, emptying, lifting, and handling.

The drum is said to be tough, light in weight, easy to lift, roll, handle and stow. It is made of material that is non-corrosive, non-absorbent and highly resistant to weathering. It is easy to fill, empty and clean and needs no venting, according to the manufacturer.

When full, it retains its shape without appreciable distortion. When empty, it can easily be further collapsed for return shipment and reuse. An empty 55-gallon synthetic rubber-fabric drum weighs less than 30 pounds.

The new type drum is considered to have safety advantages, since it needs no venting while being filled or emptied, and therefore can eliminate hazards sometimes encountered in handling certain acids and liquid combustibles. Liquids that oxidize easily can be withheld from exposure to air during removal from the synthetic rubber-fabric drum. Since inner surfaces have no corner pockets, liquid contents can be completely removed and the inside quickly cleaned.

Fiberglass Plating Tank

The Chemical Corp., Dept. MF, 54 Waltham Ave., Springfield 9, Mass.

This firm announces a new development in plating tanks—a light weight, yet strong plating tank made of resin-impregnated fiberglass. The tank is said to be suited for many types of metal finishing operations and solutions.

The tank is claimed to resist attack by most acids and alkalies, and to be very economical. Best of all, the tank is made from non-critical materials and is available on short delivery time. The tank can be easily repaired should it spring a leak, it is claimed. It has no seams, welds, or rivets, is re-inforced at points of strain, and is available in 2, 3, or 4 ply.

The tank material is claimed to resist all concentrations of HCl and H_3PO_4, chrome plating solutions, 10% sulfuric acid, 22% nitric acid, and most organic solvents.

Further details and specifications are available by writing to the above address.

Bright Nickel Bath with Levelling Properties

The Gill Corp., Dept. MF, 5317 St. Clair Ave., Cleveland, O.

This firm announces their new Smoothex nickel plating process, which is claimed to have the outstanding combination of bright plating plus good levelling proeprties. Based on a

modified Watts formula, the new bath makes use of specially developed brightening agents which are added to the bath as liquid addition. The bath operates at a pH of 4.0-5.0, and is said to have unusual ability to plate nickel over itself and to give a nickel plate that remains active for long periods of time, requiring no activation before chrome plating.

In addition to depositing a very bright plate, the bath is said to provide a levelling effect better than that obtained even in dull or semi-bright baths specially formulated for their levelling effect only. The firm claims that the new bath is now in operation in several of the nation's largest manufacturing plants. Complete details may be obtained by writing to the above address.

Rust-Proofing Process

Detrex Corp., Dept. MF, Box 501, Detroit 32, Mich.

Suggested as a replacement for cadmium or zinc in many rust-proofing applications, superior corrosion resistance is claimed for Perm-Cote, a new phosphate coating material developed by the above firm.

When immersed in a solution of the material, iron and steel surfaces are chemically converted into a dark gray, uniform, dense, non-metallic phosphate coating. After rinsing, the highly absorbent coating is impregnated with a rust-proofing oil known as Perm-Oil, giving the products a corrosion-proof layer that is dry to the touch.

Standard salt spray tests indicate a resistance well in excess of the 36 hours required in U. S. Army Specification 57-0-2c, Type II, Class B, according to the firm.

Long in supply and low in cost, the new process is of particular interest at this time.

Full information, including corroborative tests made by government agencies and private industry, is available upon request.

Acrylic Filter Cloth

Textile Fibers Dept., Carbide & Carbon Corp., Dept. MF, 30 E. 42 St., N. Y. 17, N. Y.

A new filter cloth, made of acrylic staple fibre and called Dynel, is available for a wide range of industrial filtering applications, according to the above firm.

The advantages of this new fabric

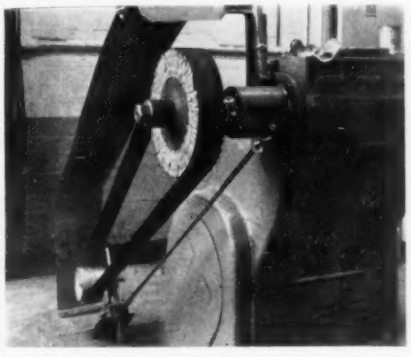
are said to be its high resistance to practically all acids, alkalies, and solvents, with good wet strength and dimensional stability. Concentrated HCl and concentrated Caustic Soda are among the materials easily handled with this material it is claimed. In addition, the cloth is mildew-proof, easy to clean, and non-stretching. It also is claimed to be non-ravelling at edges cut with a hot knife.

Remote Control for Backstand Idlers

Behr-Manning Corp., Dept. MF, Troy, N. Y.

This firm, manufacturers of coated abrasives, announces the development of a remote control arm for use on backstand installations in conjunction with the Delta Idler Unit.

The advantages claimed for the use of this remote control arm are: (1) That the operator has, at all times,



complete control of belt tracking, particularly in cases where narrow belts and wheels are used, 1½" and narrower. (2) The elimination of down-time in cases where belt guards have to be removed for belt tracking alignment. (3) Any belt alignment desired can be easily and quickly obtained by the operator from the front operating position of the polishing lathe.

Black Oxide Process

The Mitchell-Bradford Chemical Co., Dept. MF, 2446 Main St., Stratford, Conn.

This firm, manufacturers of the well-known Black Magic blackening processes, announce a new black oxide process for iron and steel known as Black Magic (Type A.).

Black Magic (Type A.) is a one bath-one salt solution and operates at a temperature of 290°F. It requires only 6½ lbs. of Black Magic salts per gallon of blackening solution. This is claimed to result in a lower cost for the initial blackening solution and a lower

cost for the replenishment of the solution drag-out. Because of the lower operating temperature and the low concentration of Black Magic salt per gallon, the solution is highly fluid and this results in a minimum of loss from drag-out of solution on the work.

This new black oxide finish is claimed to have higher corrosion resistance than regular black oxide finishes, due to the black iron oxide (Fe_3O_4) formed being a specific ratio of FeO to Fe_2O_3 to form a type of black iron oxide Fe_3O_4 which will absorb a larger amount of the final oil, wax, etc. used as the final dip.

Black Magic (Type A.) is also claimed to be self-rectifying and will rectify build-up of colloidal red iron oxides in the bath. Steel parts with brazed areas can also be processed through the Black Magic solution without any difficulties, it is claimed. This rectification is accomplished with the use of non-poisonous chemicals.

Bonding Silicone Rubbers to Metals

General Electric Co., Dept. MF, Pittsfield, Mass.

A new chemical development that makes possible a bond between silicone rubber and metals or ceramics that is stronger than the rubber itself, is announced by the above firm.

Designated as G-E 81267 primer, this new development is a thin, light-colored liquid. By using it, G-E silicone rubber 81223 can be bonded to almost any surface, it is claimed. Bonds to glass, ceramics, aluminum, steel, tin, and copper are possible, and sheer strength measurements of bonds on steel are said to be approximately 700 lbs. per sq. in. A unique feature of G-E 811267 primer is claimed to be its ability, in most cases, to develop a bond strength greater than the strength of the rubber at any stage of the cure.

The technique of applying and using this primer is quite simple and easily fits into the fabricating techniques now employed with the newer G-E silicone rubber compounds. To mold and bond these G-E silicone rubbers to a surface, it is necessary to first remove all grease and dirt from the surface. The primer is then applied by dipping and draining, spray, or brushing. The film should then be allowed to air-dry for 20 minutes. Some surfaces, such as tin, require a short heat treatment to complete the drying. The surface is then rinsed with water and dried.

The primed surface can now be molded under pressure at 125°C. against freshened G-E high-strength silicone rubber compound from 10 to 20 minutes, or 20 to 25 minutes in 40 p.s.i. steam, and may usually be removed from the mold hot.

The development of G-E 81267 primer makes possible a wide variety of silicone rubber-to-metal molded products which include shock and engine mounts that resist both high and low temperatures. Also improved rubber-glass laminated structures are now possible, and G.E.'s new high-strength silicone rubber in conjunction with G-E 81267 primer can be used as an adhesive with unusual new properties.

Masking Tapes

Behr-Manning Corp., Dept. MF, Troy, N. Y.

This firm has recently offered for industrial application a new line of paper-backed, pressure-sensitive tapes under the trade name Behr-Cat Brand Masking Tapes.

Considerable research and field testing are said to have resulted in a superior tape that answers the requirements of the many technical consultants and specialists who cooperated with company engineers in the development of this new line of tapes.

Designed for a wide variety of applications, the new tapes are adapted to masking, as in spray or brush painting; stencilling, as in screen or stencil painting; packaging, as for shipment or storage; sealing, as for dust-

proof containers; holding, as for loose parts in assembly; labeling, as on goods transferred from original container; and surface protection, as glass from chipping, and equipment in transit.

Correct tackiness for faster application, better flexing to contours, deadstretch that prevents creep-under of paint, thinness that prevents build-up of paint, ideal performance in high temperature work, better balance between tensile strength lengthwise and tear strength crosswise, and "no residue" strip-off in unmasking, are among the quality benefits claimed by Behr-Manning.

Behr-Cat Brand Masking Tapes are available in standard length rolls of all popular widths, boxed or bulk packed.

Basket for Sulphuric Acid Anodizing

Belke Manufacturing Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.

Production anodizing of rivets and other small parts at low cost is provided by an anodizing basket announced by the above firm.

Designed for use in sulphuric acid solutions, the basket is made of bakelite with an aluminum center stem. The cover is equipped with a compression spring for maintaining the positive contact pressure essential to uniform anodizing results.

In use the parts are dumped into the basket and shaken down. Then the cover is pinned down under compression by means of the pin through the stem.

The basket illustrated is 12-½" high by 5-¾" I.D. Other sizes are furnished to specifications.

Wet Blast Equipment

The Cro-Plate Co., Inc., Dept. MF, 747 Windsor St., Hartford 5, Conn.

A new metal-working procedure in the fields of high-speed, accurate deburring, descaling, stock removal and general surface finishing is now available through the use of the Cro-Hone Pressure-Blast, a self-contained, low-cost, easily installed wet-blaster.

This machine is said to reduce maintenance and down time by eliminating all moving parts.

The Cro-Hone Pressure-Blast also uses the basic technique of wet-blasting to increased advantage by increasing the speed of the abrasive slurry as it is forced against the work. Conventional speeds have been trebled, it is said. The power and accuracy of the abrasive blast can best be judged by the fact that a 3/16" diameter hole can be bored in a piece of ½" thick plate glass in 38 seconds, according to the firm.

The work to be finished is inserted in the 30" x 30" cabinet through the front hand-holes or side doors. Both entrances are fitted with splash-proof guards which allow neat, leakage-free installation. Mechanical, knee actuating valves and controls are located within easy reach at the front of the cabinet, and a large, clear-view window

enables the operator to clearly watch progress of the work.

The machine is constructed of type No. 304 stainless steel, and copper tubing is used throughout to avoid corrosion in the equipment and the work produced. Heavy-walled extruded vinyl hoses resist wear and offer maximum flexibility and ease of handling, it is claimed.

Installation is simple and inexpensive. One ½" water connection and one ½" air connection is all that is needed for full operation.

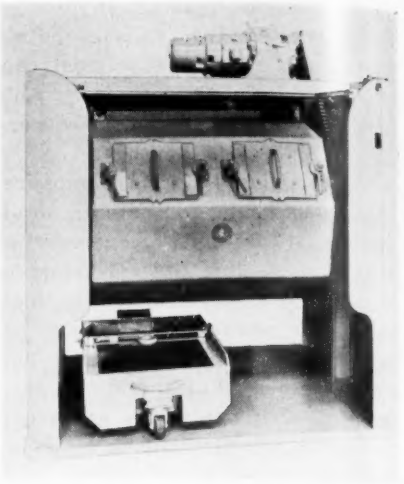
Tumble Finishing Machines

Crown Rheostat & Supply Co., Dept. MF, 3465 N. Kimball Ave., Chicago 18, Ill.

The Tumble Finishing machine illustrated has been redesigned and improved to bring many new benefits to users of finishing equipment. These machines are used almost universally in iarcraft, armament and other metal working operations to deburr and smooth rough edges and sharp corners at low cost.

Featuring Crown "Buffer Strip Lining" which makes possible on-the-spot replacement, these machines keep at a minimum the "down-time" needed for lining renewal. Semi-soft rubber linings are also available.

A variable-speed drive gives the operator a wide choice of speeds for the processing of steel, die-cast or other metal parts. An automatic timer control assures a definite operating time thus avoiding the over or under-running of work during the processing period.



Added features include new lightweight doors with "full-grip" door lock handles. A newly designed full gasket door plate has been added to provide a water tight door seal and make replacement of the door gasket a simple quick job.

A complete catalog covering machines and auxiliary equipment is available upon request.

Business Items

Clemons to Handle Cincinnatti Area for Udylite

William F. Clemons has been named sales engineer for *The Udylite Corporation's* Cincinnati territory which covers southern Ohio, *L. V. Nagle*, vice-president in charge of sales, announced today.

A graduate of Lawrence Institute of Technology in Detroit, where he re-

Wm. F. Clemons

ceived a degree in chemical engineering. Clemons has a thorough schooling and experience in every phase of electroplating. Upon graduation, he joined The Udylite Corp. as a control-chemist in the Customer Service Laboratory, where customers' plating solutions and methods are tested and analyzed. He later was assigned to Udylite's field technical staff, servicing Udylite plating processes in customers' plants throughout the country. Immediately prior to his appointment to the Cincinnati office, Clemons was a member of the Udylite Sales Department in the Detroit area.

Mr. Clemons' office will be listed under The Udylite Corporation, Roselawn Center Building, Section & Reading Road, Cincinnati 37, Ohio.

Wolcott New Wyandotte Manager of Manufacturing

F. B. Wolcott

Appointment of *Frank B. Wolcott* as General Manufacturing Manager of *Wyandotte Chemicals Corp.*, has been announced by *Stephen T. Orr*, Vice-President - Manufacturing.

Wolcott was formerly in charge of manufacturing operations for the New Jersey Zinc Company.

A native of Cleveland, Ohio, the 44-year-old Wyandotte newcomer obtained his degree in geology mining at Princeton in 1930. He joined New Jersey Zinc as an engineer in the company's mines in West Virginia and in 1933 was transferred to the Palmerton works where he was, successively, in charge of slab zinc and metal manufacturing until he became superintendent of the plant in 1948.

Mr. and Mrs. Wolcott already have established residence in the Down River area. They have two children, one of whom is a midshipman at the United States Naval Academy in Annapolis, Maryland.

As General Manufacturing Manager for Wyandotte, Wolcott will have supervision over the company's chemical, compounding, quarrying, mining and transportation activities, most of which are in process of expansion.

Walker to Head Sales For Richardson-Allen

Wesley S. Block, Jr., President of *Richardson-Allen Corp.*, manufacturers of selenium rectifiers, announces the appointment of *Dr. Harry N. Walker* as Vice-President in Charge of Sales. He has been a Director of the company for some time. Prior to joining Richardson-Allen, he was General Sales Manager of the B. G. Corporation, manufacturers of aircraft and automotive spark plugs, and prior to World War II had been Professor and Chairman of the Department of Electrical Engineering at New York University.

Giering Opens Plant in East Haven

Giering Metal Finishing Co., specializing in baked enameling, plating, anodizing, lacquering, woodgraining and industrial hard chrome, announces the opening of a plant at 194 Main Street, East Haven, Conn. The facilities consist of new and modern equipment capable of producing the finest in metal finishing.

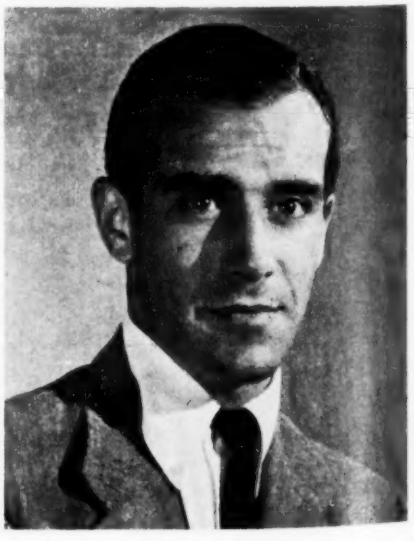
Mr. Giering is very well known in this field, being associated with metal finishing for the past sixteen years in the Hamden, Conn. area.

Cro-Plate Appoints Two New Officers

R. C. Allen

Theodore L. Brantly, Jr., President of *The Cro-Plate Co., Inc.*, industrial chrome plating organization and manufacturers of metal plating and finishing equipment, has announced the appointment of *Robert C. Allen* as Treasurer, and *Alan R. Burman* as Vice-President.

Mr. Allen, a C.P.A., joins the company from the Springfield office of Miller, Morgan & Co., Pittsburgh, Pa., accounting firm, where he was resident manager and senior consultant specializing in corporative structure, audits and taxation for several leading manufacturers in the New England area. Mr. Allen is a graduate of American International College and holder of a Master's degree in Business Administration from Boston University.



A. R. Burman

Mr. Burman comes to the company from Wilson, Haight & Welch, Inc., Hartford advertising agency, where he served as Account Executive and Copy Chief. In his new position he will be concerned with the organization of a new department in charge of advertising and sales which he will head.

Turco Appoints Keating Sales Manager

Turco Products, Inc., Los Angeles, Chicago, Houston, and Newark, manufacturers of industrial chemical cleaning compounds, announces the appointment of *Donald A. Keating* as Railroad Div. Sales Manager.

A native of Phoenix, Arizona and a descendant of an old-time railroad family, Don was educated in Los Angeles and received his B.S. in chemical

Donald R. Keating

engineering at Cal. Tech. During the war, he served in the Navy as Lieutenant j.g. on a L.S.T., engaged in Pacific amphibious operations.

Since joining Turco, five years ago, Don has served in the Chicago Div. as Technical Representative for the Mid-West states, and in Los Angeles both as Process Engineer and Assistant Technical Dept. Manager, handling the direction of the development and control sections of that department.

Cleveland Abrasive Firm Expands

Cleveland Metal Abrasive Co., of Cleveland, Ohio is completing the construction of a concrete block and steel addition to its plant on East 67th Street. This plant addition is designed to increase the production of Cleve-

land's normalized and cut-wire shot approximately 50%.

New equipment being installed includes additional normalizing furnaces, wire cutting equipment, and crushing rolls for the production of hard iron grit.

This expansion is another step in Cleveland Metal's continuing effort to maintain and increase the efficiency of its productive capacity. The company now operates plants in Cleveland and Howell, Mich.

Patent Granted for Coating with Vinyl Plastisols; Can be Licensed

A recently issued patent, No. 2,550,232, covering the "*Method of Coating Metallic Articles with Vinyl Resin Dispersons*," has been assigned to *Industrial Lining Engineers*, 3527 Smallman St., Pittsburgh 1, Pa. The patent was granted to *John W. Donnell* and *Kenneth Tator*. The firm is ready to license interested parties to perform this type of work.

Solventol Holds Sales Conference

Solventol Chemical Products, Inc., 15841 Second Boulevard, Detroit 3, Mich., held its Second Annual Sales Convention, April 23 through April 27 at the Sheraton Hotel in Detroit.

Several new metal cleaning products were presented to the sales force. These have been developd to fulfill needs arising from specialized applications in new defense production.

Also, the opening of a new machining and spray washing equipment manufacturing plant, located at Vi tor and Brush Streets in Highland Park, Mich., was announced. *Howard B. Downs*, General Sales Manager, stated that the new plant will manufacture Solventol metal cleaning and spray washing equipment to be used in conjunction with Solventol di-phase metal cleaning compounds.

Axford New V.P. at A. S. Campbell

Winfield S. Axford has been elected executive vice-president and a director of *A. S. Campbell Co.*, Boston producer of automotive parts, and its 141-year-old ferrous foundry subsidiary, *Hunt-Spiller Mfg. Corp.*, *Neil C. Raymond*, president, announced.

School Comes to the Plating Plant

Because of today's need for improved production and lessened wastage, particularly in plating plants operating under defense contracts, *Joseph B. Kushner*, Electroplating Engineer, is pleased to announce the inauguration of a new service to help meet this need.

The service consists of a school for the manufacturers' plating personnel, "right at the plant," in which they are taught the principles behind the work they are doing, and improved practical methods for doing that work so that they can perform their jobs more efficiently and with greater teamwork and thus improve production.

Two instruction courses are available on the plant premises, each one personally conducted by Joseph B. Kushner, who has been successfully operating the Kushner Electroplating School for the past three years. The first course is an intensive one-week course in the Principles of Electroplating. The second course, also given in the period of a week, deals specifically with the plating operations conducted in the plant where the course is being given. All text material is supplied by the School and will be retained by the plant personnel for study and reference. As far as possible, the class training periods will be chosen so that they do not interfere in any way with plant production time.

Manufacturers who desire to improve their plating results are invited to write to *Joseph B. Kushner Electroplating School*, Stroudsburg, 18, Pennsylvania.

Macbeth Corp. Doubles Plant Facilities

The Macbeth Corp., and subsidiaries, Newburgh, N. Y., manufacturers of pH meters, photometers, optical instruments and color matching lights announce the acquisition of a second plant in Newburgh, N. Y. for the manufacture of optical and electronic instruments.

This represents a doubling of present manufacturing and research facilities and a fourfold increase in its plant size since the firm moved to its present site from New York City early in 1950. The expansion has been necessitated by a continued increase in business.

The new plant will be in operation about June first of this year.

Kenneth W. Montfort Joins Pennsalt of Washington

Kenneth W. Montfort has joined *Pennsalt of Washington* as district sales representative, it has been announced by *William J. F. Francis*, Assistant Manager of Sales of the West Coast organization.

Mr. Montfort will make his headquarters at the company's Portland, Oregon, office and will devote his time to the sales and service of agricultural and industrial chemicals in Oregon, Colorado, Utah and Southern Idaho. He will report to *Mr. L. M. Shanaman*, Asst. Mgr. of Sales at Portland.

Mr. Montfort is a native of Blaine, Wash., and was Assistant Manager of Northwest Wholesale's Chemical Supply Dept. in Wenatchee, Wash., prior to his present position with Pennsalt.

Pennsalt Names McWhirter, Nelson, Works Managers

The *Pennsylvania Salt Mfg. Co.*, has appointed *G. A. Nelson* works manager of the Wyandotte, Mich., works, and *James M. McWhrter* works manager of the company's southern plants, it was announced today by *William F. Mitchell*, vice-president.

The new positions were created in line with the company's current expansion plans. Mr. Nelson was formerly superintendent at Wyandotte and initially will combine these duties with those of his new position. Mr. McWhirter, formerly superintendent at Calvert City, Ky., will be responsible for operations at that plant and at Montgomery, Ala., and Bryan, Tex.

At the same time Mr. Mitchell announced that *Ritner W. Tomlinson*, formerly superintendent of the company's plant at Cornwells Heights, Pa., has been appointed superintendent at Calvert City, and *Herman J. Eichenhofer, formerly* assistant superintendent for processes at Wyandotte, has been appointed superintendent at Cornwells Heights.

Francis E. Murphy, formerly Wyandotte production supervisor, has been appointed assistant superintendent, processes, to replace Mr. Eichenhofer. Mr. Eichenhofer will work with the company's Central Engineering Department in Philadelphia for the balance of 1951 on development of new processes.

Joseph T. Gormally, previously with the Philadelphia office, has been appointed assistant superintendent at Cornwells Heights and will be acting superintendent until Mr. Eichenhofer assumes his duties there full time.

Man-Gill Appoints Porter for Northern Ohio

The appointment of *E. S. Porter* to handle industrial and commercial cleaning compound sales in Northern Ohio has been announced by *The Man-Gill Chemical Co.*, Cleveland, O., suppliers of industrial metal cleaning, maintenance, and basis chemicals for Ohio industry.

Mr. Porter's responsibilities will include advisory service for metal fabricators on problems of product finish, involving use of proper metal cleaning compounds to prepare surfaces for plating, painting, enameling, etc. Prior to his association with Man-Gill, Mr. Porter headed his own sales agency specializing in automotive products.

Mr. Porter attended Fenn and Cleve-

E. S. Porter

land Colleges where his studies included business administration, sales and accounting. He has spent the past fifteen years in industrial and sales fields, having been with the Lincoln Electric Co., for ten years in production control, and with the Carter Hotel in sales and auditing before opening his own sales agency.

National Rack Co. Opens Chicago Plant

In keeping with their steady expansion program, *The National Rack* and *Imperial Plating Rack Companies* announced recently the opening of a new Chicago plant.

This new associated company will be known as *The American Rack Co.* with factory and offices at 23-24 West Lake Street, Chicago, Ill.

Mr. Edsel L. Faulman, President of all NaRaCo Companies, stated today that *Mr. William Zube* will be Manager of this complete operation.

The American Rack Co.'s facilities will improve service to the midwest, as their operations are to extend as far west as Wisconsin. The entire new Chicago plant will be equiped with the latest machinery and other modern production units. With this plant in operation, prompt rack service is now available for anodizing, plating, painting, and conveyors.

Laboratory Demonstrations Featured in Wyandotte Industrial School

Eleven of the topics discussed at the second product application school for Wyandotte Chemicals representatives were keyed with tests and demonstrations in the company's industrial research and development laboratories. Particular emphasis during the week-long conference was placed on demonstrating metal cleaners and detergents which meet the unusual and altered requirements of the national conversion program.

The school was directed by *Dr. Roy E. Heath*, manager Industrial, Railroad and Aircraft Detergents, assisted by members of the research, development and technical service staffs, and by *Robert J. Racine*, manager Industrial Sales and *James L. Ramsey*, manager Railroad Sales.

During the week, the results of several research projects were detailed. Study of field tests, case histories, and several hours "brush up" on laboratory techniques completed the school for the 10 selected industrial representatives who attended.

Dr. Snell Addresses World Petroleum Congress

Dr. Foster Dee Snell, President of *Foster D. Snell, Inc.*, New York City firm of consulting chemists and chemi-

cal engineers, presented three papers before the Third World Petroleum Congress held at The Hague May 28—June 6, 1951. All three papers, written in collaboration with members of the Snell staff, were on different phases of detergents as they are produced from raw materials of the petroleum industry.

The first, prepared jointly with Lyman H. Allen, Jr., Director of Engineering, and Robert Sandler of that department, discussed detergency from a chemical engineering viewpoint. Here the use of engineering equipment and processes to produce spray-dried detergents from petroleum raw materials were covered in detail.

The second, prepared with *Irving Reich*, discussed the advantages and disadvantages of synthetic detergents—called syndets by Snell. This paper covered the chemistry of petroleum-based syndets showing comparative values and uses for different types. Dr. Snell also delved into the most desirable syndets that could be developed in future research, his point being that such development may further revolutionize the present competitive position between the soap and syndet industries.

The third paper prepared jointly with *John R. Skeen*, Director of Market Research, discussed surface-active agents from petroleum from a market research standpoint, past production, and possible future expansion. A history of the appearance on the market of each major type of surfactant was reviewed.

Dr. Snell also visited many of his firm's associates and clients in France, England, Italy, and The Netherlands before he returned to the United States.

Reprints of the papers will be available on request in June.

National Rack Co. and Imperial Plating Rack Co. Occupy New Plants

Announcement was made recently by *Mr. Edsel Faulman*, president of both firms, of the latest expansion programs of the *Imperial Plating Rack Co.*, of Detroit, and the *National Rack Co.*, of Paterson, N. J.

In Paterson, the firm has purchased a new building at 179-181 Madison Ave., which will house the manufacturing and main offices. This division serves the eastern industrial area with a line of engineered plating racks and rack coatings. The Detroit plant, at 1613 Industrial Ave., serves the automotive industry and the mid-western states with the same high-quality production tools for plating. Both plants were established and moved into with no let-up in production, according to Mr. Faulman.

This is the second major expansion for these firms since their founding, an expansion which was dictated by the increased demand for their line of replaceable rack tips, specially constructed racks, and rack coating ser-

vice. Other officers of the firms include Vice-President *Herr* and Treasurer *Elmer Piekert*, of the National Rack Co., while *L. D. Faulman*, Vice-President, and *William Zube*, Treasurer, head of the Imperial Plating Rack Co.

S. F. Krzeszewski Elected Vice-President of American Wheelabrator

Stanley F. Krzeszewski was recently elected a vice-president of *American Wheelabrator and Equipment Corp.*, 500 S. Byrkit Street, Mishawaka, Ind. For the past 5½ years he has been Factory Manager, and will continue with these duties.

Prior to joining AWECO in 1945, Mr. Krzeszewski held a number of positions ranging from warehouse foreman through factory superintendent to plant manager.

His technical education has been in the fields of engineering, foundry practice, accounting, industrial relations, and industrial management.

Mr. Krzeszewski is Chairman of the Michiana Chapter of the American Foundryman's Society; past president of the South Bend Rotary Club; a member of the Mishawaka Chamber of Commerce, and the American Legion Post No. 50, South Bend.

Promat Div. Appoints Distributors

Ralph R. Jenkins, who was recently named Sales Manager of the *Promat Div. of Poor & Co.* has announced appointment of the following dostributors for the Promat line of metal plating chemicals and processes: *Haviland Products Co.*, Grand Rapids, Mich.; *Wagner Brothers, Inc.*, Detroit, Mich.; *Donald Sales & Mfg. Co.*, Milwaukee, Wis.; *Bart-Messing Corp.*, Belleville, N. J.; *Reynolds-Robson Supply Co.*, Philadelphia, Pa.; *Ardco, Inc.*, Chicago, Ill.

The Promat line includes: addition agents for acid cleaning; iron sequestering agents; acid and alkaline zinc baths; cadmium baths; agents for purifying, conditioning and brightening; secondary chrome film treatments for zinc, and similar products.

Wyandotte Advances Four In Industrial Sales Dept.

Due to expanding sales volume, *Wyandotte Chemicals Corp.* has established a new department to be known as the Industrial, Railroad and Aircraft Dept.

Dr. Roy E. Heath becomes manager

of the new department. Dr. Heath joined Wyandotte Chemicals in 1942, was loaned during World War II to the Manhattan Project, is a graduate of Albion College, obtained his doctor's degree from Western Reserve, and was a member of the chemical staff of Wisconsin and Western Reserve Universities. Dr. Heath has addressed and is well known to many sections of the A.E.S.

Robert J. Racine advances from Wyandotte Chemicals' Technical Service Department to the newly created post of manager, Industrial Sales. He is a graduate of Michigan College of Mining and Technology, joined Wyandotte in 1946 and has several years of selling experience in the industrial field.

James L. Ramsey, newly appointed manager of Railroad Sales, joined Wyandotte in 1945 following a degree from Indiana Technical College and employment by the Norfolk and Western Railroad. For several years past he has been a special railroad representative for the Wyandotte organization.

Edward J. Kubis joined Wyandotte Chemicals Industrial Laboratories in 1948 following graduation from University of Detroit and supervision of cleaning, plating and painting processes for Briggs Manufacturing Company. He has recently been transferred from Wyandotte Chemicals Research and Development Division to the Technical Service Department.

Left to right — Edward J. Kubis, Dr. Roy Heath, Jim Ramsey, and Bob Racine.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Baltimore-Washington Branch

The April meeting was held at the National Bureau of Standards on Tuesday, April 17th.

For the first twenty minutes the branch was treated to a technicolor film titled "*America the Beautiful.*" This film, issued by the Bond Division of the U. S. Treasury Department, por-

trays the scenic beauties that are America, and was very well received by the members present.

Following this, a "Meet the Press" type of discussion was held on plating questions. A panel of our consisting of *Dr. Blum, Charles Glock, Charles Ostrander,* and *Arthur Pierdon* answered the "wing-dings" sent in by the members. *Dr. Ab Brenner* served as moderator and did an excellent job in this capacity. *Ken Huston* carried away the only prizes, having submitted the most question (26) for which he earned $3.00, and having stumped the experts on one question for which he received another dollar.

The meeting then adjourned to informal discussions and refreshments.

Many felt this meeting to have been one of the most sociable held for quite some time.

Chicago Branch Holds Annual Ladies Night

The April meeting of the Chicago Branch, held at the Western Society of Engineers, was again a gala affair. Following last year's precedent, the ladies were invited to join in the evening's entertainment.

The meeting commenced with the usual social hour and dinner. *Dr. Monaweck* presided over his last formal meeting as President of the group, and later turned his gavel over to the new President, *Ray Ledford.*

The educational program for the evening was capably handled by *Mr. Clarence Sample,* of the International Nickel Co., who presented an informative talk on "The Behavior of Coatings Under a Variety of Tests." Relative values of Cadmium vs. Zinc; Lead and Nickel-Chrome vs. Copper-Nickel-Chrome on steel were compared as to their corrosion resistance in a variety of climates and conditions. The talk was illustrated with a series of colored slides.

Following the formal meeting an informal "get together" took place at which refreshments were served and plating problems forgotten as the ladies took over the conversations.

Plans have been evolved to expand the branch's monthly bulletin. Under the editorship of *Paul Glab* and the able assistance of *R. Scott Modjeska,* the bulletin is in good hands.

Los Angeles Branch Annual Educational Session

In tune with the tempo of the times, which finds the Southern California

area in a tremendous resurgence of plating shop expansion geared to the expanding national defense effort, The Los Angeles Branch of the A.E.S. staged a record-breaking annual educational session at Rodger Young Auditorium on April 21.

Attendance records were broken for the daytime technical sessions as well as for the dinner and dance in the evening.

President *Roy Lostutter* welcomed 150 members and guests at the morning technical conference. *Myron H. Orbaugh*, chairman of the educational committee, then introduced as the first of two nationally known speakers, *Dr. Richard B. Saltonstall*, technical director of the Udylite Corp., Detroit, Mich. Dr. Saltonstall discussed "Recent Trends and Developments in Electroplating."

He said that the two most significant developments in plating in recent years were (1) reduction in the cost of operation; and (2) improvement in the quality of the product. The main reduction in cost, he said, had been brought about through savings in labor. He stated that an outstanding trend has been the movement toward automatic machinery. The use of automatic equipment is also making great strides in the polishing and buffing end of shop work, as a result of which automatic machines make it possible to work a greater variety of parts more efficiently.

Other trends commented upon by Dr. Saltonstall were: bright plating, greater speed in plating, and developments in the physical properties of electrodeposits. Among specific trends, the speaker noted the use of low pH nickel strike on steel.

The second speaker of the morning session was *Hubert M. Goldman*, chemical engineer, Enthone, Inc., New Haven, Conn. The subject of Dr. Goldman's paper was "Chemical Conversion Coatings and Oxide Finishes." Slides were used to illustrate typical coatings and deposits discussed by the speaker.

At noon, some 150 members and guests attended luncheon in the Rodger Young Hall, at which all mention of anything pertinent to plating was taboo. *George M. Kent*, of Shepard & Kent, Inc., served as toastmaster. The annual story telling contest proved as popular as in previous years. The winner—determined by volume of applause—was *Earl Coffin*. Others participating in this feature were *Stuart*

Krentel, George Hess, Roy Darling, Herold Kroesche, Larry O'Neill, Casimir Tarzinsky and *Ed Delameter*. Nonsmoking Earl won a box of cigars.

The afternoon technical session was called to order at 2 o'clock. The first paper was one prepared by *Dr. G. Klinkenstein*, president of Maas & Waldstein Co. of Newark, N. J., on "Substitute Organic Finishes for Electroplated Coatings." It was read at the meeting by *William Vargo*, of the Smith-Davis Co.

Earl Arnold, of L. H. Butcher Co.'s Los Angeles technical staff, and *Morton Schwartz*, of Surface Alloys Co., collaborated in the presentation of the final paper, which concerned "Military Applications of Electroplating."

An exhibit of plated products was displayed in 19 booths arranged along three sides of the meeting hall, which were sponsored by 19 local firms or West Coast branches of national organizations.

The annual banquet and Ball in the evening which drew some 400 to the main ball room, climaxed the days events. A feature of the entertainment was a waltz contest in which 50 couples participated. *George Hess*, of the Mefford Chemical Co., serving as master of ceremonies of the contest in the absence of John Millhorn, who was ill, reported that the winning couple was *Mr.* and *Mrs. Edward Endemano* (he operates the Endemano Plating Co. in Huntington Park). The winners were presented with beautiful loving cups donated for the occasion by the *Kaag Mfg. Co.*, of Los Angeles.

Don Bedwell served as general chairman of the day's events. The educational features were arranged by a committee composed of *Myron H. Orbaugh, Morton Schwartz, Earl Arnold* and *Emmet Holman*.

What they are doing in the Detroit area, particularly with respect to recent developments in cleaning cycles and procedures, was outlined for members of Los Angeles Branch in a competent manner on the night of May 9 by *Stanley S. Krentel*, Detroit representative of McDermid, Inc.

Krentel, a brother of Stuart Krentel, secretary of Los Angeles A.E.S. Branch, gave a masterful survey of the more recent procedures to which the industry in Detroit is resorting to compensate for the various restrictions which have come about since the national emergency arose. His wide range of contacts in the motor city enabled him to discuss effectively developments in the average job shop as well as in such huge plating establishments as that of the Pontiac factory.

The business session was conducted by President *Roy Lostutter*. *Virgil Sciamana*, of the M.R.M. Enamelers, Santa Monica, was intiated into membership.

Don Bedwell, general chairman of the branch's annual educational session, reported that record breaking attendances made the affair the best in the branch's history and that "a substantial profit" accrued to the branch treasury.

Cincinnati Branch

Despite the belated arrival of spring zephyrs, the Cincinati Branch of the A.E.S. had an excellent turnout at its meeting on April 25, 1951 which, as usual, was preceded by an excellent meal.

The meeting was called to order by our newly elected President, *Robert D. Miller*, who gave notice that he has thorough acquaintanceship with Ro-

berts' *Rules of Order*. President Miller asked the Secretary to read the correspondence which had been received during the past month. After letters from the Buffalo and Newark Branches were read in reference to the raising of the membership fees as proposed by the Boston Branch, a discussion was held. It was the feeling that an audit of the Society should be made available to the members, and the delegates to the convention in Buffalo this summer were instructed to request such an audit, and that it be sent to all Branches for their information. A committee was then appointed to discuss the Buffalo and Newark letters, making appropriate recommendations.

Vice-President *Carl Claybaugh* reported on a picnic site but unfortunately the choice spots have already been reserved and there will be some difficulty in finding the proper location. *Kay Barry* and *Stewart Chipman* were appointed a Picnic Committee to determine the right date and place for this summer's function.

Mr. Richard W. Cook, of the Brush Development Co., Cleveland, was introduced as the evening's speaker. The developer of "The Faxfilm Method for Comparing Surface Roughness," Mr. Cook explained his process of examining surfaces on all types of metal, wood, plastics, etc., for determining defects. By the use of slides he was able to show his audience defects in various surfaces even including the skin and finger nails. A short question and answer period followed has highly illuminating talk.

The Branch enjoyed its monthly Social Hour as the guests of MacDermid, Inc., Waterbury, Conn.

New York Branch

The New York Branch of the American Electro-Platers' Society had two meetings during the month of April; on Friday, April 13th and Friday, April 27th respectively. The first of these two meetings was devoted extensively to a discussion prior to the subsequent instruction of delegates to the Buffalo Convention. The general discussion at this time gives the membership a chance to consider carefully as to how they will vote at the actual instruction. A film on the chemical effects of electricity followed the business meeting. The second meeting was devoted to a lecture by *Mr. Vernon C. Burr*, of the United Chromium Co. who gave a very informative and interesting lecture on "*Substitute Coatings For Metal.*" Mr. Burr's talk included such information as the latest restrictions on the use of metallic coatings such as nickel, copper, zinc, cadmium and chromium.

Indianapolis Branch

The Indianapolis Branch made their annual trip to Columbus, Indiana, on April 4th. An excellent steak dinner was served with more than 80 members and guests present. A short business meeting was held with election of officers being main business of the evening.

Officers elected for the year 1951-1952 were as follows.

President—*Mr. Al Kriese.*
1st Vice-President—*Mr. C. Weekly.*
2nd Vice-President—*Mr. H. Phillips.*
Treasurer—*Mr. Robert Bruck.*
Secretary—*Mr. Ed. Bruck.*
Librarian—*Mr. Elmer Lundberg.*
Board of Managers—*Mr. Tom Evans, Mr. Q. Shockly, Miss Eda Rohrabaugh.*

Following the business meeting a trip through Cummins Diesel Engine Co. was made. Here all machine operations and building of diesel engines was in progress by the night shift. This courtesy visit was arranged by Mr. T. Evans.

The Branch held their May monthly meeting with 20 members present, preceded by the usual steak dinner.

There was much discussion, suggestions and criticisms regarding our annual educational session and dinner dance held last Saturday April 28th, and plans already were laid for next year's dinner dance.

Delegates were instructed regarding several important issues to be brought up at the annual convention. The speaker of the evening was *Mr. Bert Cer Vaas*, owner of Home Plating Co. His talk gave experiences and opinions regarding the 2 years in South America and 4 years in Far East as director in charge of Military Intelligence during World War 2. His talk was most enjoyed by all present as the subject is very much of interest at the present time. The meeting adjourned with the retiring president *Mr. Claude Weekly* turning over the gavel of office to the new president, *Mr. Al Kriese*.

New England Regional Meeting

The annual New England regional meeting, sponsored by the Hartford, New Haven, Springfield and Waterbury A.E.S. Branches, was held on April 28 at the Taft Hotel, New Haven, Conn.

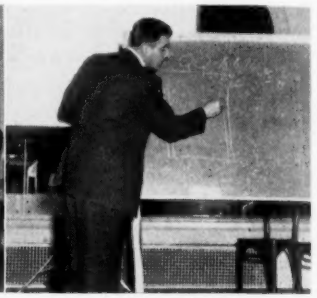
Approximately 200 members enjoyed an excellent technical session in the afternoon, while the poor ladies were suffering through a matinee performance of something inappropriately called, "A French Affair." Apparently the technical sessions were livelier and more interesting than the play.

The first speaker of the afternoon, under the chairmanship of *Malcolm Orr* of International Silver Co., was *W. D. Starr*, of the Lea Mfg. Co., who

Bill Starr and Malcolm Orr talk on NPA Rulings.

Almo Squitero, of H-VW-M, discussing Iron Plating.

Dr. Fred Lowenheim, Tin plating expert.



Harry Sanders, of Enthone, illustrates talk with a blackboard sketch.

The New York branch was well represented. Shown left to right: George Schore, Hugh Goldman, Frank Mac Stoker, Herb Julianne, Milton Nadel and Al Braun.

spoke on the various N.P.A. regulations affecting the metal finishing industry.

Dr. Fred Lowenheim, of Metal & Thermit Co., then gave a very enlightening discussion of tin-zinc alloy plating, with its commercial applications.

Iron plating, which is receiving a great deal of interest these days because of its utilization of non-critical metals, was the subject of a timely discussion by *Almo Squitero*, of the H-VW-M Co.

Dr. Harry Sanders, of Enthone, topped off the afternoon's schooling with a discussion of the various government and military specifications for finishing of aluminum alloys.

After the usual 2-hour interlude for fun, familiarity and fortification, a capacity audience jammed the Main Ballroom for the evening dinner and entertainment, the entree being the usual you-know-what. The floor show following dinner certainly made up to the ladies for the mediocre matinee performance, with versatile *Roy Picard* highlighting the show with his xylophone act.

CALIFORNIA METAL FINISHING ASSOCIATION

The Metal Finishing Association of Southern California elected directors and new officers at its May meeting. Four members of the 9-man board were elected, including *Walter Behlendorf*, of Spence Plating Co., *Jack Raskin*, of L. H. Butcher Co., *Dick Richardson*, of Progressive Plating Works, Long Beach; and *Earl Coffin*, Palace Plating Co.

The new directors, with the five hold-over board members, then elected the following new officers: President, *Frank Brown*, re-elected; vice-president, *Paul Kockritz*; treasurer, *Walter Behlendorf*.

As executive secretary to replace *Cranor Richter*, who resigned in March, the association has appointed *Harrell Smith*.

President Brown reported on his recent trip to Chicago and Detroit where he participated in conferences between representatives of the National Association of Metal Finishers and the National Production Authority. In commenting upon the association's efforts to obtain, through such conferences with the NPA, a more equitable distribution of available critical materials to job plating shops, Mr. Brown reported that the situation with respect to nickel and chrome is not very encouraging. From what he had learned at the mid-west conferences, he told his fellow members of the MFASC, they should be prepared for a lengthy period of shortages in the strategic metals.

NATIONAL ASSOCIATION OF METAL FINISHERS

Chicago Electroplaters Institute

The Chicago Electroplaters Institute has issued a report of the combined

facilities of its members, together with a complete list and addresses of member firms, in a four-page bulletin. This report was prepared for the assistance of prime contractors, government procurement agencies, and other organizations interested in the mobilization for defense production. Titled "*The Plating Industry is Ready*," this report is another one of the ways the Chicago Electroplaters Institute is helping to bring additional business to the platers in the Chicago area. Similar associations of job platers in other major cities are taking similar steps to insure that the present and immediately available plating facilities are made known to interested parties. Copies of this bulletin may be obtained by writing to the Executive Secretary, *Mr. Lewis M. Glassner*, 35 E. Wacker Drive, Chicago 1, Ill.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

South Central Meeting

The South Central Region of the National Association of Corrosion Engineers will hold their annual meeting in Corpus Christi, Texas, on October 18-20, 1951. Inquiries should be directed to association headquarters, 919 Milam Bldg., Houston 2, Texas.

THE ELECTROCHEMICAL SOCIETY

Electrochemical Society Announces Establishment of Palladium Medal

The Electrochemical Society announced recently the establishment of *The Palladium Medal of the Electrochemical Society*, to be awarded for original and outstanding contributions to the knowledge of corrosion and its control.

The Medal will be awarded biennially to a medallist selected by a committee composed of scientists prominent in the fields of corrosion and electrochemistry. The award will be open to anyone.

The medallist will be invited to address the National Fall Meeting of the Electrochemical Society at which the Medal will be presented. The first presentation will be made this year.

The Medal itself will have some interesting features of design and will be struck in the rare and precious metal, palladium.

In addition to The Palladium Medal, the medallist will receive traveling expenses and an honorarium.

Royalties from the sale of the *Corrosion Handbook*, sponsored by the Society and published in 1948 by *John Wiley & Son, Inc.*, has done much in enabling the Electrochemical Society to establish this new award.

NEW BOOK

Industrial Polishing of Metals

By Gerald F. Weill. Pub. by Iliffe & Sons, Lt., London. Available from Finishing Publications Inc., 11 W. 42 St., N. Y. 18, N. Y. 194 pages, 5½ x 8¾. Price $4.00 incl. postage.

Compared to papers on electroplating, articles on buffing and polishing are few and far between, and a newly

published technical book on this subject is indeed a rarity.

The author has apparently tried to make the book as complete as possible by including sections that are as unexpected as they are welcome. In addition to expected discussions of buffing and polishing compositions, wheels, equipment and procedures, he has included chapters entitled:—Theory of Polished Surfaces, Barrel Polishing, Electropolishing, Metal Removed by Polishing, Dust Extraction, Problems of the Polishing Shop, and Costing. Preceeding these sections, he opens with an interesting chapter on the art as practiced in ancient and medieval times.

The book is admittely written from the British viewpoint and as such serves as a valuable guide to the American investigator rather than as a "bible" of American finishing practice. A glossary of terms assists the American reader to recognize a well known object or operation by its British name.

Although many readers will disagree with the procedures recommended, it is difficult to find two individuals experienced in metal finishing, either British or American, who will agree on all details of buffing and polishing practice. This is probbaly to be expected as long as we are dealing with an art rather than an exact science. The book does, however, fill a definite and long-felt need in the technical literature of the metal finishing industry.

H. L. K.

News from California

By Fred A. Herr

Two plating supply houses and three job plating shops in the Southern California area were the victims of burglaries since the first of the year, with cadmium, now one of the metals on the acute shortage list, among the loot in each instance.

Latest to be broken into was the warehouse of the Los Angeles branch of *C. F. L'Hommedieu & Sons Co.*, from which intruders late in April are reported to have stolen 700 pounds of cadmium and lead anodes valued in excess of $2,000. Earlier this spring intruders broke into this same plant and removed some 750 pounds of cadmium.

Sundmark Supply Co., of Los Angeles, is reported to have suffered the loss of 1,500 pounds of cadmium in a recent burglary. A Los Angeles area job plating shop was allegedly broken into and burglarized of an unannounced amount of anodes early in May. Earlier in the year, the shops of the Southwest Plating Co. and Christianson Plating Co. were broken into and substantial supplies of cadmium stolen.

Stanley S. Krentel, Detroit area representative of McDermid, Inc., and Mrs. Krentel, mootred from Michigan to California during the early part of May. They spent several days in San Francisco and then visited brother *Stuart Krentel* (Spence Plating Co.) in Los Angeles, where Stanley addressed Los Angeles Branch of the American Electro-Platers' Society.

A. L. Speser, formerly owner of the Los Angeles plating and polishing firm,

A. L. Speser & Company, reports that he and *Travis Klefeld* have joined in the establishment and operation of the Travis Plating Company at 533-37 Venezia Avenue, Venice, Calif., a seashore district of Los Angeles. The plant is housed in a building specially designed for plating operations, Speser declared. Sewage and drainage facilities also are designed specifically for plating shop demands. Equipment has been provided for anodizing, Alumiliting and cadmium plating on aircraft parts, according to Speser, who estimated that the plant represents an investment in excess of $30,000 for building and equipment.

J. M. Bowman, president, Bowman Chemicals, Inc., 4600 Long Beach Blvd., Los Angeles, reports that negotiations are underway for acquiring a site for a new building which is to be planned for some 4,000 square feet of floor area. The firm specializes in metal finishes by chemical immersion processes, and also provides chemicals, supplies and gun-blueing service for gunsmiths.

Included in a $20,000,000 expansion program to be carried out during the next two years by the *Wyandotte Chemicals Corp.*, of Wyandotte, Mich., is a compounding plant in Los Angeles. This is one phase of a large expansion program.

It was a first trip to Southern California for *Hubert M. Goldman*, chemical engineer of Enthone, Inc., New Haven, Conn., who visited the West Coast during the week of April 21 to 28. Mr. Goldman came west to address the annual educational session of Los Angeles Chapter, A.E.S. on April 21. He also held consultations with West Coast Enthone representatives.

Also visiting Southern California during April were *Dr. Richard B. Saltonstall*, technical director of the Udylite Corp., Detroit, Mich., and *Edward Vermere*, president of the Vermere Corp., Malvern, Ark.

G. J. Beckwith, vice-president and general manager of Metallon Products, Inc., Los Angeles, reports the installation of several semi-automatic polishing machines for use in polishing stainless steel plumbing parts. Also newly installed were two polishing lathes, one with a 10 foot shaft.

V. E. Seigmanna, formerly production superintendent for the *Schlage Lock Co.*, San Francisco, has disposed of the *Culver Enameling Co.*, which he operated in Culver City, Calif., and has acquired ownership of *M. R. M. Enamelers*, 2234 Broadway, Santa Monica, Calif.

Bert Schireson has been appointed sales manager for Inet, Inc., Los Angeles (formerly known as Industrial Electronics & Transformer Co.). He joined the firm in a sales capacity in June, 1950, after service as a sales engineer for Consumer Chemical Products Company.

Hollywood Bronze Supply Co., manufacturers of plating shop equipment, includng "miniature" tank units for the jewelry trades, has moved offices and display rooms from 1766 North Vermont Avenue, Hollywood, and has concentrated all production, sales and display activities in its factory building at 1624 East First St., Los Angeles, *Charles Auerbach*, president, reports.

LATEST NPA ORDERS AFFECTING THE PLATING INDUSTRY

Polyethylene

NPA M-45

Effective June 1, polyethylene, widely used in the plating industry as a lining material for chemical resistant tanks, plastic tubing, and similar uses, is placed under allocation. Users of less than 500 lbs. per month are not affected. Users must state end use in purchase orders to manufacturers. There are only two manufacturers of this type material in the country. Scrap and reclaimed material do not come under this program.

Cadmium

NPA M-19

Nuts, bolts, screws, washers, threaded parts, rivets, cotter pins, automotive and aircraft fuel pump parts, battery hold-down bars are amongst the items for which cadmium plating is now permitted. This order is effective April 26.

Copper

Users of copper will be required to file a series of monthly reports of their operations. Form NPAF-83 is the one for copper platers and other users of copper in manufacturing operations. Forms are available from the Copper Division, Metals and Minerals Bureau, NPA, Washington 25, D. C.

Trichlorethylene Conservation

The National Production Authority announced a program to conserve the short supply of trichlorethylene.

NPA said manufacturers of degreasing equipment and manufacturers of trichlorethylene have agreed to cooperate in the conservation program in this manner:

1. Degreasing equipment manufacturers will assist users in obtaining maximum efficiency from use of the degreasers, thus reducing solvent usage.

2. Trichlorethylene manufacturers will reclaim trichlorethylene from use-contaminated solvent shipped back to them by the user.

A sample of the solvent should be sent the manufacturer for analysis and report on solvent content before actual shipment is made, NPA said. Such samples often contain 60 per cent to 70% of reclaimable trichlorethylene.

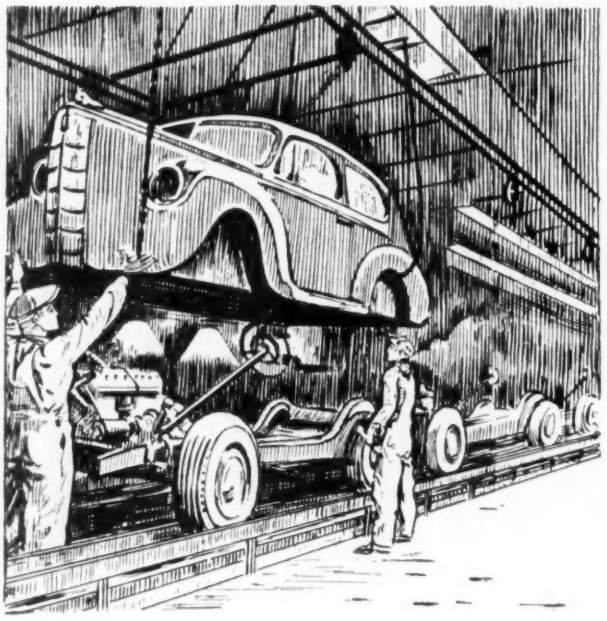
In these uses, the trichlorethylene becomes contaminated by bits of metals, abrasives or greases, and some industries have been disposing of the solvent after one use, NPA revealed.

The solvent may be reclaimed, however, through a distilling process by which the trichlorethylene content is vaporized, separated from the foreign matter and re-liquified in a pure form.

Most degreasing equipment is equipped with a still for reclaiming trichlorethylene, but NPA said that in some instances, where machines are kept in constant use, time is not taken for distillation.

Instead of disposing of used trichlorethylene, NPA said, these companies should return it to the manufacturer so that a considerable saving in the overall supply could be made.

Trichlorethylene is not under government allocation and such a program may not become necessary if the conservation program is effective, NPA indicated.



MOTOR CITY PLATING NEWS

by

Edward Turner

One plating shop made the headlines in the Detroit papers on May 11th, when *National Plated Products*, 4019 Beaufait, was the central figure in the attempted sale of 22,000 pounds of hijacked precious nickel metal.

The story goes this way — About midnight two men drove a truck loaded with the 11 tons of sheet nickel to the plant and contacted *Robert Dalton*, night foreman. Dalton called *Norman Garvey*, president of the company, and tried to negotiate a sale of the metal for $3.00 a pound. Garvey, suspicious because the truckers had no bill of lading or invoices, called the police. When the police arrived, Dalton told them that the truckers had gone for something to eat. Hours later, they still had not returned. Police confiscated the nickel.

Investigation showed that the truck had been stolen during the previous afternoon. The truck was then driven

to the Henreping Transportation Co. and hitched to the trailer load of nickel.

The nickel was en route from the *International Nickel Co.*, Welland, Ontario to Inland Steel Corp., Indiana Harbor, Ind. Because of the eventual use of the nickel in the defense program, FBI agents are assisting police in the hunt for the hi-jackers.

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The above causes this writer to wonder just why there is so much black market nickel around. There seems to be plenty of nickel for $3.00 to $3.50 a pound, if any plater wants to pay the price. Why isn't this nickel on the legitimate market where it could do the small plater, who is entitled to nickel usage, some good?

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Charley Beaubien, longtime salesman for *Wyandotte Chemical Corp.*, and who was officially retired early this year after 25 years of service, has joined *A. T. Wagner Co.*, 2700 Wight St., Detroit and is continuing in harness selling Wagner's line of supplies and equipment.

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Wyandotte Chemicals Corp. has appointed *Frank B. Walcott* as general manager of manufacturing. Formerly, Walcott was in charge of manufacturing operations for the *New Jersey Zinc Co.* Walcott will have supervision over the company's chemical compounding, quarrying, mining and transportation activities.

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Simonds Abrasive Co., of Philadelphia, has moved the Detroit office into a new warehouse at 17155 Conant Ave. The building contains 10,000 square feet of floor space and has ample trucking facilities and parking space.

This warehouse handles the Simonds line of abrasive grain and grinding wheels.

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Harding Mfg. Co., Inc., 10600 Gratiot, Detroit has added a new service particularly aimed at design engineers. Realizing that engineers would like to visualize a finished product well in advance of production, Harding now will plate any non-metallic parts formed of wood, plaster or glass. This will give the design engineer an actual idea of the appearance of a drawing board plan or model.

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Production at the Wyandotte plant of the *Pennsylvania Salt Mfg. Co.* will be increased to 23% over its present capacity. The boost will include a 20% increase in alkaline cleaners announced *George B. Beitzel*, president.

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The *Michigan Water Resources Commission* has awarded its highest classification to the filteration and waste disposal system of the Monroe plant of the Ford Motor Co.

The company's $1,000,000 waste disposal system at the new plant which produces and finishes die-castings is proof that vast industrial developments are possible without spoiling lakes and streams for wildlife.

The new plant produces wheels, radiator grilles and other parts and employs 2,000 workers.

Waste liquids containing cyanides, acids and caustics are run into huge tanks in batches and tested chemically to determine the degree of treatment necessary. Following treatment, the water is pumped into the River Baisin, and the sludge is diverted into settling lagoons.

The filtration plant is large enough to treat drinking water for a population of 40,000.

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J. A. Kloustin has joined the staff of *Saran Lined Pipe Co.*, 2415 Burdette Ave., Ferndale, Mich. as Director of Saran Rubber Sales. He is in charge of Saran rubber sales and service for the entire country. Jack will handle tank lining and the moulding program of the company and he is, at present, setting up and instructing rubber liners throughout the country in their new process of tank lining.

Kloustin will retain his position as member of the board of directors of the Saran Protective Coatings Co., an affiliate of his present company.

PATENTS

(*Continued from page 79*)

comprising a mass of binder material and comminuted abrasive material distributed there-through, said abrasive material consisting essentially of multi-sized particles derived by grinding tailings of conglomerated copper ore.

Bright Nickel Plating Bath

U. S. Patent 2,528,902. *P. W. Moy and W. P. Karash, assignors to The Harshaw Chemical Co.*

An aqueous, acid electroplating bath for production of a bright cathodic deposit of nickel, said bath essentially consisting of a nickel ion yielding material selected from the group consisting of nickel sulfate, nickel chloride and mixtures thereof, a buffer and, as an addition agent, a material of the class consisting of thiophane sulfonic acid and its alkali metal, nickel and cobalt derivatives wherein the metal atom replaces the hydrogen atom of the SO_3H group, said addition agent being present in concentration from 0.005 to 0.5 gram per liter, the pH of said solution being from 3.0 to 5.0.

Manufacturers' Literature

Detergents for Steam Cleaning

Oakite Products, Inc., Dept. MF, 18 Thames St., N. Y. 6, N. Y.

An interesting discussion of how steam-detergent cleaning saves time and work and helps cut costs in connection with industrial maintenance operations is provided in an illustrated folder available from the above firm, manufacturers of industrial cleaning and related materials.

The folder defines steam-detergent cleaning as the simultaneous application of *three* different actions: (1) the *physical* action of steam pressure and hot water working their way through successive layers of grease and dirt; (2) the *dissolving* action of heat on oils, greases and other deposits; and (3) the *chemical* action of the detergent in penetrating, wetting and emulsifying surface deposits. This simultaneously-applied combination of efficiency factors, the folder asserts, provides the ultimate in cleaning speed and thoroughness. Typical instances in many branches of industry where this method offers substantial time and work-savings in connection with equipment clean-up operations are carefully enumerated in the folder.

In addition to listing specific tasks in industry for which steam-detergent cleaning has demonstrated exceptional effectiveness, the folder also supplies detailed specifications of the types of steam-cleaning equipment available from this manufacturer, and offers free helpful data on the preparation of efficient working solutions for use with this equipment.

Metal Cleaner Booklet

Cowles Chemical Co., Dept. MF, 7016 Euclid Ave., Cleveland 3, O.

Four metal cleaners are discussed in a new booklet, "Heavy Duty Cleaning —The Fast Way," just released by the above firm.

The booklet was especially designed to explain how and why operating time can be cut and cleaner costs lowered when Cowles HD-N Cleaner is used in heavy duty metal cleaning. It points out types of soil removed and the physical and chemical methods used in their removal. HD-N is discussed fully, along with Cowles LP Cleaner for removing buffing and drawing compounds, Cowles SK Cleaner for oil, fat

and grease removal and Cowles LIXOL Cleaner for use in pressure-spray washers.

Chemical Resistant Plastic Pipe, Fittings

American Hard Rubber Co., Dept. MF, 11 Mercer St., N. Y. 13, N. Y.

Complete engineering data on tubing, pipe, valves and fittings of Ace-Saran and Ace-Parian (polyethylene) plastics are given in a new bulletin just released by this firm. Resistant to most chemicals, these materials are lightweight, tough, durable, have high impact strength. Of particular interest are tables of properties and tables of resistance to a long list of common chemicals. The bulletin also gives bursting and working pressures, standard sizes and weights, etc., and offers helpful information on the fabrication of complete systems from these new plastics. The attractive, well organized catalog is 16 pages, printed in two colors.

Coated Abrasives Bulletin

Behr-Manning, Dept. MF, Troy, N. Y.

The latest issue of the B-M Bulletin shows various forms of coated abrasive special shapes to aid in burring and polishing in hard-to-get-at places. These shapes are said to greatly lessen the amount of hand work and time involved in finishing difficult parts. The many illustrations show these various abrasive shapes in actual use in metal working operations. Copies are available on request to the above address.

Manufacture of Metal Abrasives

Metals Disintegrating Co., Dept. MF, Elizabeth, N. J.

A 16-page illustrated book describing the company and its affiliates has just been issued by the above firm, manufacturers of metal powders, metal pigments and metal abrasives.

The book is designed to acquaint people with the company and its affiliates from the standpoint of who they are, what they make, where they are located, and the plant facilities that are against available for defense needs in their field.

Photographs of the various plants of the company are shown. Illustrated on one page is a map showing the plant, branch office, distributor and warehouse locations throughout the country and Canada.

Shown are pictures of the various laboratories maintained by the company and the part which each plays in the development and production if its varied line of products.

Heavy Duty Cleaning

Cowles Chemical Co., Dept. MF, Cleveland 3, O.

A bulletin issued recently by this firm shows how Cowles HD-N cleaner, as well as their other heavy-duty cleaner formulations can be used to reduce cleaning problems in the plating and painting department. Some of their materials are alkaline (silicated) cleaners, while other types include emulsifiable type and emulsion cleaners for special applications where maximum cleaning ability under heavy production schedules is required. Copies of the booklet are available on request.